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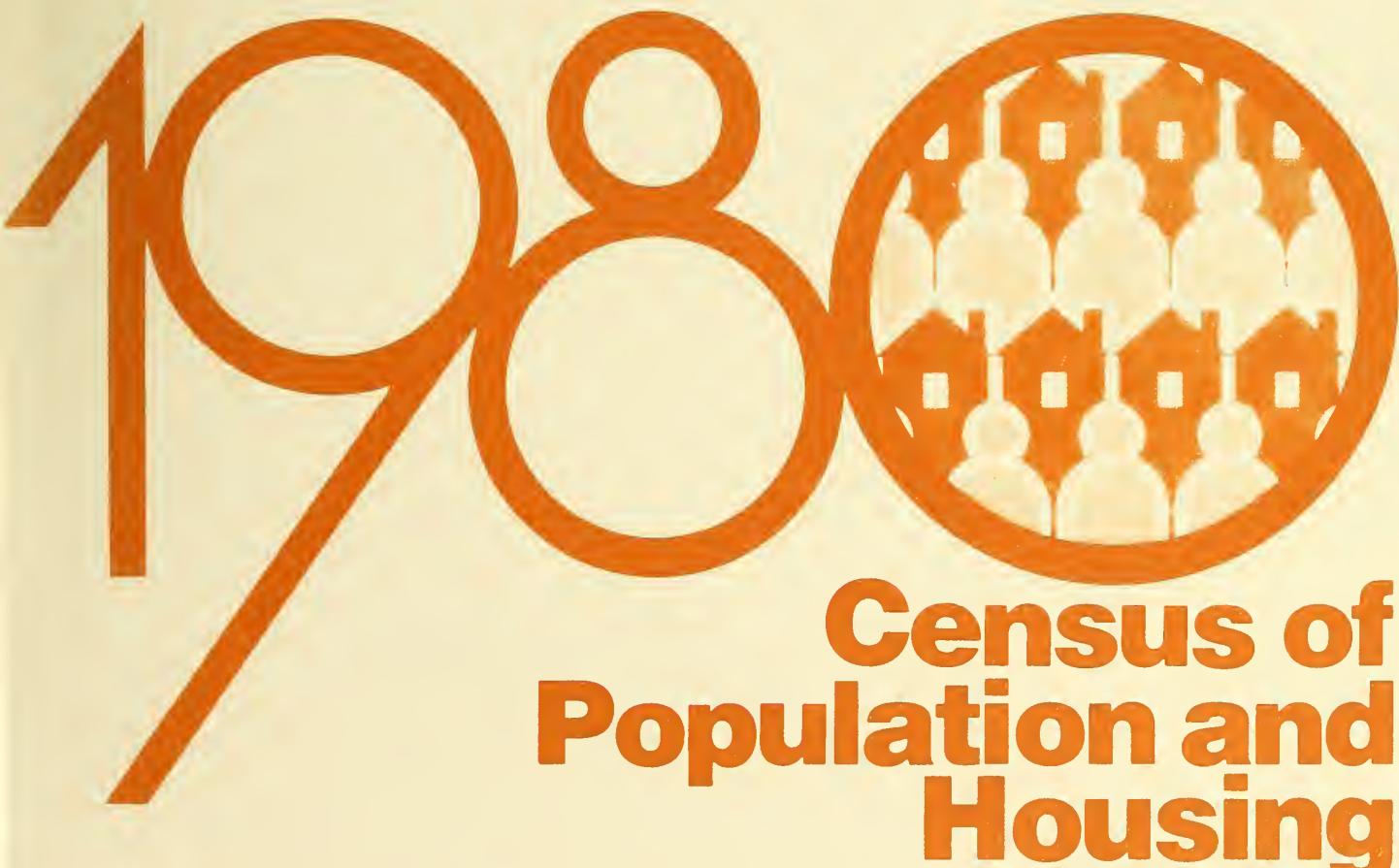
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The Coverage of Population in the 1980 Census

By:

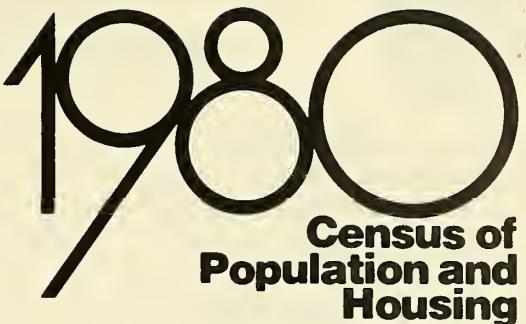
Robert E. Fay
Jeffrey S. Passel
J. Gregory Robinson
With Assistance From
Charles D. Cowan



Census of Population and Housing

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The Coverage of Population in the 1980 Census

By:

Robert E. Fay
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**Census of
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The Coverage of Population in the 1980 Census

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Chapter 1.—Introduction and Summary

1.A. SCOPE OF THE REPORT

This report presents the findings from the evaluation of the accuracy of the population counts from the 1980 Census of Population and Housing.

The coverage of the population in the decennial censuses, generally, and in the 1980 census, in particular, has been consistently more complete than any comparable national sample survey. Nonetheless, censuses are subject to many sources of error, and the resulting counts necessarily fall short of perfect accuracy.

Because of the constitutional importance of the census for purposes of the apportionment of the House of Representatives, and because of the other varied uses of the results, the U.S. Bureau of the Census has maintained a continuing commitment to evaluate the accuracy of the population counts. Beginning with the 1950 census, major assessments of the completeness of coverage of each census have been conducted.¹ Since recent U.S. censuses are so complete, however, it has proved difficult to develop alternative estimates of the true population to serve as a standard against which to measure census accuracy.

This report discusses both the conclusions and limitations of two different evaluations of the accuracy of the 1980 census. The first of these is based on the method of demographic analysis. This method constructs estimates of the total U.S. population and its components by race, age, and sex from aggregate statistics on births, deaths, immigration, emigration, past censuses, Medicare enrollment, and other sources. The second evaluation, the 1980 Post-Enumeration Program (PEP), employs sample survey methods to measure directly the distinct components of census error for a sample of persons, thereby to estimate the net error of the census. Section 1.B further describes the basic features of these two approaches.

Both demographic analysis and the 1980 PEP are subject to substantial limitations on their accuracy. Section 1.C states some of these limitations, which are a major subject of the balance of this report. Indeed, as will be shown, the estimates from demographic analysis and the 1980 PEP are in conflict in important respects.

In spite of the limitations of the methods, the available evidence appears to support a number of general conclusions concerning the completeness of coverage of the 1980 census. Section 1.D summarizes the principal findings of the evaluations. The section distinguishes between those conclusions strongly supported by the available data, and other findings based on comparatively less conclusive evidence.

The 1980 Census of Population and Housing was the subject of far more litigation than any previous census. The number of lawsuits filed against the Census Bureau doubtless stemmed from the increased importance of the census counts in a number of formulas for the allocation of funds by the Federal Government. For example, population was one of the factors considered in the General Revenue Sharing Program at the time. A remedy sought by most jurisdictions in these suits was the adjustment of the census counts for alleged

undercoverage. The Census Bureau concluded that it was not feasible to adjust the counts from the 1980 census on the basis of the available data in such a way as to assure that the adjusted census counts would more accurately reflect the true distribution of the 1980 population than the official counts. Section 1.E further elaborates the Census Bureau's position on adjustment and cites other documents in which this policy has been enunciated. Most of this report, however, will devote relatively less attention to the question of adjustment and the complex issues that have emerged from the ensuing public debate on this subject. Instead, the primary purpose of this report is to present in detail both the results of the principal evaluations of the coverage of the 1980 census and the specific limitations of these findings.

Section 1.F describes the overall organization and content of the report. By furnishing an overview of the scope and interrelationship of the chapters, the section should assist readers intending to read portions of the report selectively.

1.B. METHODS OF ASSESSING CENSUS COVERAGE

As stated in the previous section, demographic analysis and the 1980 PEP represent the two principal assessments of 1980 census coverage. Since the original work by Ansley J. Coale,² demographic analysis has been used in the evaluation both of recent censuses and, retrospectively, of earlier censuses. Demographic analysis employs basic demographic relationships, such as the equations: (1) relating change in population to births, deaths, immigration,

¹For example, U.S. Bureau of the Census, *The Post-Enumeration Survey: 1950*, Technical Paper No. 4, Washington, DC, 1960; U.S. Bureau of the Census, *Evaluation and Research Program of the U.S. Censuses of Population and Housing, 1960: Record Check Studies of Population Coverage*, Series ER 60, No. 2, Washington DC, 1964; U.S. Bureau of the Census, *Evaluation and Research Program of the U.S. Censuses of Population and Housing, 1960: Accuracy of the Data on Population Characteristics as Measured by the CPS-Census Match*, Series ER 60, No. 5, Washington, DC, 1964; and U.S. Bureau of the Census, *1970 Census of Population and Housing Research Program: Estimates of Coverage of Population by Sex, Race, and Age: Demographic Analysis*, PHC(E)-4, Washington, DC, 1974.

²Ansley J. Coale, "The Population of the United States in 1950 Classified by Age, Sex, and Color—A Revision of Census Figures," *Journal of the American Statistical Association*, Vol. 50 (March 1955), pp. 16-54.

and emigration; and (2) reflecting aging of the population over time, to analyze aggregate statistics on births, deaths, immigration, emigration, enrollment in Medicare, and other sources. The result of these analyses is an estimate or sets of estimates of the total population classified by age, race, and sex, to which the census counts may be compared.

Several of the aggregate statistics employed in demographic analysis are incomplete. For many of these series, an adjustment for incompleteness has been incorporated in the development of the demographic estimates of coverage. For example, registered births have been corrected for underregistration on the basis of tests conducted in conjunction with the 1940 and 1950 censuses and a sample survey in 1968. The accuracy of demographic analysis thus depends on complex issues; in this instance, for example, not on whether births have been completely registered, but on whether the adjustments incorporated in the demographic analysis have appropriately corrected the birth statistics for underregistration.

Demographic analysis provides not only a national estimate of total population but also detailed national estimates for age, race, and sex groups. Changes in reporting patterns for race in the 1980 census introduced additional complications into the analysis. Consequently, the 1980 census data had to be modified for purposes of analysis to correspond to earlier patterns of reporting. Also, most of the analysis for 1980 has been conducted according to the dichotomy Black/White-and-other races.

Demographic analysis is not equally effective at providing coverage estimates for other categories, however. Separate results for persons of Spanish origin, for example, are of obvious importance, but cannot be addressed by demographic analysis because the necessary historical information is not uniformly available in the underlying data used to develop demographic estimates (e.g., birth registration systems). Although some exploratory work has been conducted for States,³ demographic analysis is less

accurate in measuring subnational variations in coverage. Furthermore, demographic analysis is completely unable to provide estimates for state areas because the required data either do not exist or are not sufficiently accurate.

The 1980 PEP attempted through sample survey methods to measure directly the components of census error. Samples of persons were matched against the census enumerations to estimate the proportion of the population omitted from the census. The census count also contains errors in the opposite direction from omissions, e.g., erroneous inclusions in the census of persons who should not have been enumerated at the given address in the census. A separate sample was selected from the census in order to estimate erroneous inclusions.

The PEP produced estimates of the net error of the census for the same national categories as demographic analysis: age, sex, and race. Additionally, the PEP also furnished coverage estimates for groups for which estimates from demographic analysis were unavailable. The most important of these are estimates for the Hispanic population and for individual states.

1.C. LIMITATIONS OF THE METHODOLOGIES

In addition to the lack of geographic detail from demographic analysis and the random variability arising from the use of sampling methods in the PEP, other methodological limitations of these studies prevent either from being considered flawless alternatives to the census count. An overall assessment of the effect of such limitations constitutes a principal objective of this report.

As already noted, the application of demographic analysis for purposes of estimating the U.S. population requires the correction for incompleteness of some of the component data, such as registered births and Medicare enrollments. Other statistics, such as those for deaths and for some components of net immigration, are incorporated without adjustment, and yet are not free from error. Quantification of the effect of these errors on the estimates derived by demographic analysis has proved difficult, but for the most part it appears that such errors are not so severe as to

invalidate the broad conclusions, based on the estimates from demographic analysis, about census coverage.

Measurement of the number of undocumented (illegal) immigrants in the United States represents a salient exception to the preceding generalizations about the accuracy of coverage estimates provided by demographic analysis. For the most part, undocumented immigrants do not appear in the record systems used to construct the estimates through demographic analysis. In recent years, the magnitude of this component of population has gained in importance relative to the magnitude of the census undercount. Unfortunately, no method independent of the 1980 census has furnished reliable estimates of the total number of undocumented residents in 1980. Thus, the strength of the conclusions based on demographic analysis depends, in part, on the assumptions that must be made on the number of undocumented aliens in the country. In this report, estimates of 2 to 5 million undocumented aliens illustrate a range of possible values.

The 1980 PEP shared many of the same deficiencies that have consistently accompanied studies of census coverage employing matching techniques. The sample surveys have tended to miss the same types of persons as the census, even within specific identifiable demographic subgroups defined by age, race, and sex. In turn the number of missed persons in some demographic categories is systematically underestimated. Secondly, many PEP sample cases were incomplete, and estimates of undercount—particularly of total undercount—were sensitive to the assumptions for missing data. In general, problems of missing data also appeared in earlier studies. Mistakes in matching also considerably affect the estimated net undercount with this methodology. In order to represent the uncertainty in the analysis, several alternative sets of estimates derived from the PEP data are presented in this report.

1.D. EVALUATION FINDINGS

In spite of the limitations both of demographic analysis and of the PEP, the evidence from these studies is sufficient to draw a number of conclusions concerning the completeness of coverage of population in the 1980 census.

³Jacob S. Siegel, Jeffrey S. Passel, Norfleet W. Rives, Jr., and J. Gregory Robinson, "Developmental Estimates of the Coverage of the Population of States in the 1970 Census: Demographic Analysis" *Current Population Reports, Special Studies* P-23, No. 65, Bureau of the Census, Washington, DC, 1977.

1. Within the bounds defined by a set of reasonable alternative assumptions about the magnitude of the population of undocumented residents, demographic analysis implies that the net census undercount of the total population was significantly lower in 1980 than 1970, or indeed any previous census for which such analytic comparisons are possible. This conclusion rests in part upon results of an analysis indicating that approximately 2 million undocumented residents were included in the 1980 count. Demographic analysis also implies that the count of the legally resident population was the most complete in 1980 of any census. The PEP data do not contradict the finding that the net undercount of the census was indeed quite low in 1980.

2. The improvement in coverage in the 1980 census compared with previous censuses extends to the Black and White-and-other-races populations separately. In other words, the count of the Black population was relatively more complete than in any previous census, including 1970, as was the count of the White-and-other-races population. Again, the PEP evidence is generally consistent with this conclusion.

3. In spite of the gains in coverage of the 1980 census, demographic analysis shows that the undercount rate for the Black population continued to exceed substantially the undercount rate for the White-and-other-races population. Indeed, there appears to have been relatively little, if any, change in the difference between the rates for these two groups. In a set of demographic estimates to be discussed in detail later in this report, the estimated percent undercount for Blacks in 1980 is 5.9 percent, compared to 0.7 percent for White-and-other races. The estimated difference, 5.2 percentage points, falls close to the 5.8-percentage-point difference for 1970 based on undercount rates of 8.0 percent and 2.2 percent, respectively. Other sets of demographic estimates show substantially the same pattern.

The PEP supports this conclusion to the extent that different estimates from the PEP consistently show considerably higher

rates for Blacks than for White-and-other races. The estimated racial difference from the PEP varies somewhat among different sets of PEP estimates. In some instances, the measured difference approximates that based on demographic analysis, although some sets of PEP estimates show this difference to be only half as large.

4. The PEP provides the only evidence on the undercount of the Hispanic population in 1980. The PEP results suggest a differential undercount rate for Hispanics of approximately the same magnitude as the differential undercount of the Black population. Some sets of PEP estimates show Hispanic undercount rates somewhat below the rate for Blacks, while the reverse holds for other sets of estimates. Consistently, however, the Hispanic undercount rate exceeds that for the non-Hispanic population.
5. Demographic analysis indicates substantially higher rates of undercount for males than for females. This difference by sex appears both for the overall population and for Blacks and for White-and-other races separately. Demographic analysis has consistently found such differences for every census conducted since 1940.

The PEP fails to corroborate these differential undercount rates by sex. The evidence from demographic analysis is so strong and internally consistent, however, that its results are regarded as more correct. By implication, the PEP failed to measure fully the relatively higher undercount of males.

6. Demographic analysis also indicates that census undercount rates vary considerably by age. In particular, large differences in undercount rates by sex occur principally in the range of ages 25-59 for each race group. The PEP captured some of the same pattern of variation by age, although it failed to capture the prominently higher undercount rates for adult males.

Any conclusions concerning geographic variation in census coverage are necessarily more tentative. Demographic analysis, which provides the foundation for most of the preceding conclusions, was not carried out on a subnational basis in 1980, and,

thus, the PEP becomes the principal source of data on this question by default. Because of the PEP's methodological limitations, any statement about apparent geographic variation in net census error is necessarily speculative. Nonetheless, one finding of the PEP appears supported by outside evidence:

7. Based on evaluations of earlier censuses and a demographic analysis of state-of-birth data for 1970,⁴ the South historically has appeared to experience a disproportionately higher undercount. Until the 1980 census, undercount rates were generally highest in the South, lowest in the North, and intermediate in the West. In 1980, however, the PEP obtained for the South an estimated undercount close to the national average. Thus, the combined evidence from these studies suggests a significantly greater increase in census coverage between 1970 and 1980 for the South than for any other region.

The hypothesis of a relative improvement in coverage in the South in 1980 was further supported by results from the Census Bureau's program of population estimates. The population estimates for regions in 1980, when based on the population figures from the 1970 census and estimates of population change, fell much further below the 1980 census values for the South than for other regions. Thus, the evidence from the intercensal estimates program corroborates a presumed relatively greater improvement in coverage in the South in 1980.

In addition to providing evidence, although limited, about the completeness of census coverage for groups or areas for which demographic analysis does not, the PEP also furnished detailed information about components of census error. In turn, knowledge of the magnitude and nature of such components of error contributes to the planning and design of future censuses. Several conclusions emerge from the detailed analysis of the PEP results; among them are:

8. The PEP confirmed results from the 1980 Housing Unit Enumeration Duplication Study that an appreciable fraction of the total census count, probably in excess of 1.1 percent, represented

⁴ibid.

duplicate enumerations of persons already in the census. Although equally thorough evaluations of duplications had not been conducted for earlier censuses, the evidence implies much lower levels of duplication then. Thus, regrettably, duplication receives dubious credit for part of the improvement in 1980 in net census coverage.

9. Geographic mistakes in assigning housing units to the appropriate census work units appeared far more extensive in rural areas enumerated through the new "prelisting" procedure, than where more traditional census procedures were used.
10. The net coverage error of the census, although relatively small, really represents a balance between omissions of persons from the census and erroneous enumerations in the census. The two balancing components are substantially larger than the net error of the census.

These and similar findings are presented in later chapters of this report and in a series of internal Census Bureau reports, the Preliminary Evaluation Results Memoranda (PERM) series.

1.E. THE ISSUE OF CENSUS ADJUSTMENT

The Census Bureau has investigated the magnitude and characteristics of the census undercount since the 1950 census. This program of evaluation has served two purposes: to inform users of census counts of possible limitations, and to provide insight vital to the Census Bureau's continuing effort to improve census-taking procedures. The studies described in this report fall within this tradition of census evaluation.

As an indirect consequence of the Census Bureau's attempts to evaluate the completeness of the censuses, many outside the agency have suggested that evaluation findings should be reflected in some manner as adjustments to the census counts,

and that the resulting adjusted census counts should replace the counts produced by the census for some or all official purposes. Indeed, a number of jurisdictions sought, through lawsuits, adjustment of the 1980 census counts. In particular, suits by the city of Detroit and by the city and State of New York centered primarily on this issue and were tried in Federal district courts and courts of appeal.

Vincent Barabba, then Director of the U.S. Bureau of the Census, stated the agency's official position on adjustment in the *Federal Register*, Volume 45, December 16, 1980, pages 82871-82885. This notice announced the decision to publish unadjusted census counts as the official findings of the 1980 census unless a court decision prohibited or restricted this action. The document also summarized the complex process by which this decision had been reached. This position had been developed after extensive consultation with Congress, public officials, census advisory groups, professional organizations, and other interested parties.

The December 16, 1980 decision specifically did not rule on the possible incorporation of census adjustment in post-censal estimation. However, the considerations leading to the decision not to adjust the counts were later extended to the issue of post-censal estimation.

This report will not attempt to review or to elaborate further the technical, legal, and political issues surrounding adjustment of the 1980 census. Interested readers may consult published remarks by Bailar⁵ and Wolter⁶ for recent representations of this position. This report partially contributes to the understanding of these issues,

⁵Barbara A. Bailar, "Counting or Estimation in a Census—A Difficult Decision," *Proceedings of the Social Statistics Section*, American Statistical Association: Washington, DC, 1983, pp. 42-49.

⁶Kirk M. Wolter, "Comment" on "Regression Models for Adjusting the 1980 Census," by D.A. Freedman and W.C. Navidi, *Statistical Science*, Vol. 1 (Feb. 1986), pp. 24-28.

however, by analyzing in detail the technical limitations of the evaluation methodologies.

The National Academy of Sciences⁷ has published a review of the adjustment issue that contains a number of observations on the 1980 experience.

1.F. ORGANIZATION OF THE REPORT

The next three chapters present the demographic analysis of the undercount of the 1980 census. Chapter 2 describes the methods employed to construct estimates of the U.S. population. Chapter 3 gives the findings from demographic analysis about the coverage of the 1980 census and other recent censuses. The fourth chapter discusses the possible implications of the 1980 census undercount for various demographic statistics, such as birth rates and dependency ratios.

The discussion of PEP follows. The fifth chapter of the report reviews census procedures, summarizes PEP procedures, and describes dual-system estimation. The sixth chapter outlines several methodological limitations of the PEP results. Twelve sets of estimates, presented in chapter 7, illustrate the effects of methodological limitations on the interpretation of the PEP findings.

The eighth chapter compares and contrasts the findings from demographic analysis with those from PEP.

The appendices cover specific technical or background issues and give detailed estimates not presented in the main report.

Many of the analyses and procedural descriptions summarized in this report appear in more complete form in other documents, particularly the PERM series.

⁷Constance F. Citro, and Michael L. Cohen (eds.), *The Bicentennial Census: New Directions for Methodology in 1990*, National Academy Press: Washington, DC, 1985.

Chapter 2.—Method of Demographic Analysis

The two general types of methods for measuring census coverage are analytic methods and record matching; both types were applied to evaluation of the 1980 census. The principal record matching study—the Post-Enumeration Program (PEP)—is described in the next section, chapters 5-7 of this report. This section of the report, chapters 2-4, discusses in detail the results of the demographic analysis phase of the 1980 census coverage evaluation program.

The first chapter in this section, chapter 2, describes the method of demographic analysis in general terms and then as applied to the 1980 census. This chapter includes a discussion of the derivation of the estimates, how the results of demographic analysis should be interpreted for the 1980 census, and the general limitations of the method. In chapter 3, the major results of demographic analysis are presented, including measures of relative coverage of the 1970 and 1980 censuses, alternative estimates of coverage of the resident population in the 1980 census (including and excluding undocumented immigrants), and detailed estimates of coverage for race, sex, and age groups. The results are discussed and compared with coverage estimates for previous censuses. The final chapter in the section, chapter 4, discusses the implications of the findings for various demographic measures. Comparison of the results of demographic analysis and the results of the other evaluation method, PEP, is reserved for chapter 8 of this report.

Detailed descriptions of the basic data and methodology used to develop the demographic estimates have been presented in the Census Bureau's internal Preliminary Evaluation Results Memorandum (PERM) series. Appendix C contains a comprehensive list of references, including the PERM series, for the estimates based on demographic analysis. These materials describe fully the assumptions underlying the estimates and evaluate the quality of the results.

This report presents a general statement of the method and assessment of the quality of the demographic estimates.

No formal estimates of the precision of the demographic estimates of the U.S. population have been published. The Bureau of the Census is investigating a method for assessing the approximate range of error in the demographic estimates of coverage (an analogue to a confidence interval). References and preliminary results of this research are also cited in appendix C.

The estimates of coverage derived by demographic analysis for the 1980 census and earlier censuses presented in this report represent extensions and improvements of estimates previously presented by the Census Bureau. As such, they supersede all previous estimates.¹ Although the estimates shown in this report for the 1960, 1970, and 1980 censuses differ from those previously published, conclusions regarding the relative levels of coverage of groups in the various censuses and between censuses are virtually unaffected by the changes in the estimates.

2.A. THE GENERAL METHOD OF DEMOGRAPHIC ANALYSIS

Demographic analysis as a tool for census evaluation involves first developing estimates for the population in various categories, such as age-sex-race groups, at the

census date by the combination and manipulation of various types of demographic data. The estimated values are then compared with the corresponding census counts to yield a measure of net census coverage:

$$\text{Census coverage rate} = \frac{\text{Census count}}{\text{Demographic estimate (or estimated population)}} \quad (2.A.1)$$

and

$$\text{Census undercount rate} = \frac{1.0 - \text{Census coverage rate}}{\text{Census coverage rate}} \quad (2.A.2)$$

The foundations of the demographic method are the logical consistency and interrelationships of the underlying demographic variables and the data used to measure them. These data are drawn from sources essentially independent of the census being evaluated. They include: birth, death, and immigration statistics; expected sex ratios, life tables, etc.; historical series of census data; and data from sample surveys. The data are corrected for various types of errors and, as such, are assumed to be more accurate than the census being evaluated. The overall accuracy of the method obviously depends on the quality of the demographic data and the corrections.

Methods of demographic analysis are widely used by demographers to make population estimates. Demographic analysis has been used at the Bureau of the Census for over 40 years to develop population estimates and projections as well as estimates of census coverage. The particular methods and data used in demographic analysis are not fixed. As analytic methods evolve over time and new data become available, they can be incorporated into the estimates. Similarly, assumptions underlying the estimates are subject to change based on new information. As a consequence, the demographic estimates of census coverage for a particular census may change over time since historical data analyzed with demographic techniques are the basis for the estimates. The effects of

¹U.S. Bureau of the Census, *Current Population Reports*, Series P-23, No. 115, "Coverage of the National Population in the 1980 Census by Age, Sex, and Race: Preliminary Estimates by Demographic Analysis," by Jeffrey S. Passel, Jacob S. Siegel, and J. Gregory Robinson, Washington, D.C., 1982; Jeffrey S. Passel and J. Gregory Robinson, "Revised Estimates of the Coverage of the Population in the 1980 Census Based on Demographic Analysis: A Report on Work in Progress," *Proceedings of the Social Statistics Section*, 1984, American Statistical Association, Washington, DC, pp. 160-165.

Chapter 2.—Method of Demographic Analysis

such changes on demographic estimates of coverage for the censuses of 1980 and 1970 are discussed later in this chapter. (See also table 2.1.)

Estimates for the total population resulting from demographic analysis provide measures of net census error. When demographic analysis is applied to a specific age-sex-race group in the census, the technique provides an estimate of net error that combines both coverage and reporting error. Although demographic analysis has limitations, they are of a different character from those affecting record-matching techniques. Demographic analysis, for example, is not generally affected by sampling error in contrast with survey-based record-matching techniques. However, as with all estimation techniques, demographic analysis must rely on a number of assumptions, some of which cannot be empirically verified. In spite of such limitations, following the 1970 census, demographic analysis provided "preferred" estimates of coverage for the United States as a whole.²

The particular procedure used to estimate coverage nationally in 1980 for the various demographic subgroups depends primarily on the nature and availability of the required demographic data. Figure 2.1 summarizes in a schematic Lexis diagram the cohort data and estimation procedures for each age group. In brief, the principal estimates presented in this report are derived as follows:

1. Estimates of the population under age 45 in 1980 for both sexes and each race category (White, Black, and other races) are based directly on births for 1935 to 1980 corrected for underregistration. The adjusted births are carried forward to later census dates with statistics and estimates for deaths, immigration, and emigration (i.e., components of change) using the basic demographic accounting relationship:

$$\text{Population} = \text{Births} - \text{Deaths} + \text{In-migrants} - \text{Out-migrants} \quad (2.A.3)$$

²U.S. Bureau of the Census, *Census of Population and Housing: 1970, Evaluation and Research Program*, PHC(E)-4, "Estimates of Coverage of Population by Sex, Race, and Age: Demographic Analysis," by Jacob S. Siegel, Washington, DC, 1974.

2. Estimates of the White population aged 45 to 64 years in 1980 are based on revisions of estimates of total White births initially derived by Whelpton for 1915 to 1935.³ The estimates are carried forward to 1940 with life table survival rates and to subsequent census dates with the same components of change used for ages under 45 in 1980.
3. Estimates of the Black population aged 45 to 64 years in 1980 are based on estimates for this cohort in 1960 (i.e., when it was 25 to 44 years of age). The estimates for females aged 25 to 44 years in 1960 were derived by Coale and Rives, principally using techniques of stable population analysis;⁴ the estimates for males in 1960 are based on expected sex ratios. The estimates for both males and females are carried forward to 1970 and 1980 and backward in time to previous census dates with components of change.
4. Estimates of the other-races population for females aged 45 to 64 years in 1980 are derived from assumptions about the consistency of age patterns of coverage in the 1950 to 1980 censuses for this cohort. The estimates for other-races males in these ages in 1980 are developed from expected sex ratios. The estimates for 1980 are carried backward in time to previous census dates with components of change.
5. Estimates of the population aged 65 years and over in 1980 for both sexes and all race groups are developed from aggregate Medicare enrollments, adjusted for underenrollment. The estimates for 1980 are carried backward in time to previous census dates with components of change.

³National Office of Vital Statistics, *Vital Statistics—Special Reports*, Vol. 33, No. 8, "Births and Birth Rates in the Entire United States, 1909 to 1948," by P.K. Whelpton, Washington, DC, 1950.

⁴Ansley J. Coale and Norfleet W. Rives, "A Statistical Reconstruction of the Black Population of the United States, 1880-1970: Estimates of True Numbers by Age and Sex, Birth Rates, and Total Fertility," *Population Index*, Vol. 39, No. 1, January 1973, pp. 3-36. See also, U.S. Bureau of the Census, PHC(E)-4, *op. cit.*

Earlier estimates of coverage for the 1980 census based on demographic analysis were published in *Current Population Reports*, February 1982 and presented in a paper at the annual meeting of the American Statistical Association in August 1984.⁵ This present report offers revised demographic estimates of coverage for 1980 that supersede all previous estimates. Different methods are used in the preliminary and revised estimates for some age-sex-race groups; some differences are the result of the unavailability of data for the preliminary estimates, and other differences represent the development of new, improved methodology. The primary revisions include:

1. Substitution of final data covering 1978-1980 for provisional data on births, deaths, and immigrants, representing a net change of +130,000 (or 0.06 percent) in the estimated total population.
2. Use of aggregate Medicare data from 1980 for estimating the population aged 65 and over in 1980; the net change in estimated total population is +370,000 (or 0.16 percent).
3. Use of new estimates of births for estimating the White population aged 45 to 64 in 1980, which adds about 815,000 or 0.35 percent to the estimated population.
4. Adjustment of data on net legal immigration, particularly the racial groupings, for all ages. These changes mainly affect the race distribution, not the estimated population.
5. Allowance for undocumented immigrants living in the United States in the calculation of the estimated resident population in 1980.

For 1980, the net effect of the revisions described is to increase the undercount estimates based on demographic analysis from the preliminary estimates. For example, the undercount rate of the

⁵U.S. Bureau of the Census, *Current Population Reports*, Series P-23, No. 115, *op. cit.*; Jeffrey S. Passel and J. Gregory Robinson, "Revised Estimates of the Coverage of the Population in the 1980 Census Based on Demographic Analysis: A Report on Work in Progress," *op. cit.*

legally resident population increases from 0.5 percent to 1.0 percent. (See table 2.1.) The increase mainly affects the White population.

In comparing the current estimates with those previously published for other censuses, it should be noted that there have been a number of other revisions, often in opposite and offsetting directions. The revisions in the estimates for 1980 also lead to increases in the most recently published estimates of undercount rates for the 1970 and 1960 censuses. However, in spite of the many changes, the current estimates for 1970 are virtually the same as "preferred" estimates published after the 1970 census (table 2.1). Most revisions have been small, but the rather large revision attributable to reestimation of White births for 1915-1935 was almost completely offset by new estimates of emigration for 1950-1970. Even though the revised undercount rates tend to be higher than those published previously, the 1980 census still represents a substantial improvement in coverage over previous censuses. Furthermore, the revisions have almost no effect on relative differences in coverage (by age, sex, or race).

2.B. INTERPRETATION OF RESULTS FROM DEMOGRAPHIC ANALYSIS

The amount of undercount in a population or a subgroup of the population, such as an age-sex-race group, is the difference between the estimated population and the census count:

$$\text{Census undercount} = \text{Demographic estimate} - \text{Census count} \quad (2.B.1)$$

However, differences between the estimated resident population based on demographic analysis, as described previously, and the census counts, as published, cannot be interpreted directly as census undercounts for a number of reasons. For the differences to represent net census undercounts, the two populations (i.e., the census and the demographic estimate) must be defined the same. Two major problems affect the comparisons for 1980—changes in the reporting and coding of racial groups in the 1980 census and the presence of undocumented immigrants in the country and in the census counts in 1980.

2.B.1. UNDOCUMENTED IMMIGRANTS

The exact number of undocumented immigrants⁶ in the United States is a demographic mystery that has been puzzling demographers for years. This unknown population complicates the measurement of undercount with demographic analysis since undocumented immigrants are residents of the United States and, as such, should be included in the demographic estimate of the resident population. When the preliminary results from demographic analysis were released in 1981 and 1982, little was known about the number of undocumented immigrants in the country or the number who were counted in the 1980 census.⁷ These initial coverage estimates made no allowance in the demographic estimate of the resident population

⁶This group, undocumented immigrants, has been referred to by a number of different terms, including: illegal aliens, undocumented aliens or workers, illegal entrants, clandestine entrants, and nonlegal residents. In this report, the preferred term is undocumented immigrants. The group is defined as "a noncitizen physically present in the United States who entered the country illegally and has not regularized his or her situation, or who has violated his or her terms of entry." This definition comes from Kenneth Hill, "Illegal Aliens: An Assessment," in National Research Council, National Academy of Sciences, *Immigration Statistics: A Story of Neglect*, Report of the Panel on Immigration Statistics, Daniel B. Levine, Kenneth Hill, and Robert Warren (editors), National Academy Press: Washington, DC, 1985.

Hill's definition includes persons who enter the country without inspection or with falsified documents, persons who enter legally but overstay their visa period or in some way violate their terms of entry (by taking employment, for example), and persons who enter as permanent residents but become deportable for some reason. Note that many of these persons have documents. Nonetheless, the term "undocumented immigrants" will still be used as a convenient way of referring to this group. For purposes of undercount estimation, there is one further restriction on the definitions. "Undocumented immigrants," in most usages, refers to persons whose usual residence is in the United States; temporary migrants and commuters are excluded.

⁷For a discussion of the status of estimates of undocumented immigrants in 1980, see Jacob S. Siegel, Jeffrey S. Passel, and J. Gregory Robinson, "Preliminary Review of Existing Studies of the Number of Illegal Residents in the United States," in *U.S. Immigration Policy and the National Interest, The Staff Report of the Select Commission on Immigration and Refugee Policy, Appendix E: Papers on Illegal Immigration to the U.S.*, Washington, DC, 1980.

for undocumented immigrants in the United States. However, research conducted at the Census Bureau over the last several years has shown that the 1980 census count includes about 2 million undocumented immigrants.⁸ Thus, the census count for 1980 includes both legal residents and undocumented immigrants:

$$\text{Total census count} = \text{Legal residents counted in the census} + \text{Undocumented immigrants counted in the census} \quad (2.B.2)$$

However, the preliminary demographic estimate of the population represented only legal residents, so that the preliminary estimate of undercount was derived from differently-defined populations:

$$\text{Preliminary census undercount estimate} = \text{Demographic estimate of legal residents} - \text{Total census count} \quad (2.B.3)$$

or,

$$\text{Preliminary census undercount estimate} = \text{Demographic estimate of legal residents} - \left[\begin{array}{l} \text{Legal residents counted in the census} \\ + \end{array} \right] \text{Undocumented immigrants counted in the census} \quad (2.B.4)$$

As a consequence, the preliminary demographic estimate of the undercount previously published was too low, by at least 2 million persons (the size of the final term in equation 2.B.4).

In this report, we have used two strategies to make the demographic estimate of the population comparable to the census figure, so that the difference between the two can be interpreted as net census undercount. One approach, which produces an estimate of the total undercount, involves adding an estimate of the total number of undocumented immigrants residing in the country in 1980 to the demographic estimate of the legally resident population. The difference between this augmented estimate and the census would then represent the undercount of the total resident population:

⁸Robert Warren and Jeffrey S. Passel, "A Count of the Uncountable: Estimates of Undocumented Aliens Counted in the 1980 United States Census," *Demography*, Vol. 24, No. 3 (August 1987), pp. 375-393; Jeffrey S. Passel and Karen A. Woodrow, "Geographic Distribution of Undocumented Immigrants: Estimates of Undocumented Aliens Counted in the 1980 Census by State," *International Migration Review*, Vol. 18 (Fall 1984), pp. 642-671. See also material cited in appendix C.

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$$\text{Total census undercount} = \left[\text{Demographic estimate of legal residents} + \text{Estimate of total undocumented immigrants} \right] - \text{Total census count} \quad (2.B.5)$$

Unfortunately, even though Census Bureau research has narrowed the range of estimates of the undocumented immigrant population,⁹ the range of reasonable estimates is still large relative to ranges for other components in the demographic estimates. To represent this uncertainty, we introduce several estimates of the size of the undocumented immigrant population and produce a range of undercount estimates.

The other approach to dealing with the undocumented immigration component involves modifying the census counts to make them comparable to the demographic estimate. In particular, the estimates of undocumented immigrants counted in the 1980 census can be subtracted from the census figures (by age, sex, and race). The resulting figure represents the census count of the "legally resident population."

$$\text{Census count of legal residents (estimated)} = \text{Total census count} - \text{Undocumented aliens counted in the census (estimated)} \quad (2.B.6)$$

The demographic estimate of the population that does not include an allowance for undocumented immigration is also an estimate of the "legally resident population." The difference between the estimate and the census count of legal residents can thus be interpreted as the net undercount of legal residents of the United States in 1980:

$$\text{Census undercount of legal residents} = \text{Demographic estimate of legal residents} - \text{Census count of legal residents} \quad (2.B.7)$$

The quantities estimated by equation 2.B.5 (total census undercount) and 2.B.7 (census undercount of legal residents) can be the same or different. Both figures are based on the same demographic estimate of legal residents, but the figures for undocumented immigrants (in equations 2.B.5 and 2.B.6) may differ. For 1980, this report presents one set of coverage estimates that excludes undocumented immigrants,

i.e., estimates for the legally resident population, based on equation 2.B.7 and four sets that include undocumented immigrants, i.e., estimates for the total population based on equation 2.B.5.

The 1980 census is the first one in recent years for which there is evidence that undocumented immigrants were *counted*, in the census. Demographic and anecdotal evidence suggest the presence of significant numbers of undocumented immigrants in the United States in 1970, but much smaller numbers in 1960 and few, if any, in 1950 and 1940. However, none of these censuses counted undocumented immigrants in significant numbers. Thus, for the censuses of 1940 through 1970, there is no distinction between the census count of the total population and the census count of legal residents (i.e., the final term in equation 2.B.2 is zero). However, for 1970 (and to some extent 1960), the demographic estimate of the total population, which includes undocumented immigrants, is larger than the estimate of legal residents; for 1940 and 1950, we do not distinguish between the two estimates on the assumption that the number of undocumented residents in those years was negligible.

For the census of 1970, this report includes five sets of coverage estimates corresponding to the five sets shown for 1980. One set excludes undocumented residents from the demographic estimate and, thus, represents coverage of legal residents only.¹⁰ The other four sets represent coverage of the total population and include different assumptions about the total number of undocumented immigrants in the country in 1970. The four assumptions

correspond to the four assumptions for 1980.¹¹ (See section 3.B.1.)

For 1960, only two sets of coverage estimates are presented. One includes only legal residents in the demographic estimate of the population (equation 2.B.3) and one includes a small number of undocumented immigrants (equation 2.B.5). The census counts are again the same in both sets of estimates (like 1970, but unlike 1980). For 1940 and 1950, only one set of coverage estimates are presented, based on equation 2.B.1.

2.B.2. RACIAL DEFINITIONS

Comparison of the demographic estimate with the census count (as in equation 2.B.1) for *subgroups* of the population requires that the subgroups be defined the same way in both data sets. In the 1980 census, changes in the practice of reporting race, particularly on the part of the Hispanic population, and in coding and classifying racial groups have created a major inconsistency between the 1980 census data and historical data series, including censuses, vital statistics, and immigration records. Thus, it is not possible to compare the demographic estimates for the principal racial groups (White, Black, and other races) directly with the published census figures to derive meaningful coverage estimates.

About 40 percent of the Hispanic population counted in 1980, or over 5.8 million persons, did not choose one of the specified races listed on the census questionnaire, but chose the "other" category instead. For the 1980 census, a modification was made in the census coding procedures in the treatment of persons who, in response to the race question, chose "other" race and wrote in a national origin designation of a Latin American country (e.g., Mexican, Venezuelan, or Cuban) or a Hispanic origin group (e.g., Puerto Rican, Chicano, or Hispano). These persons remain

¹⁰ Note that unlike 1980, there is no distinction in 1970 between the total census count and the count of legal residents because there is no evidence that the 1970 census counted undocumented immigrants. For coverage rates of legal residents and total residents in 1970, the numerators are the same census counts (unlike 1980), whereas the denominators differ by the estimate of total undocumented residents (like 1980).

¹¹ These estimates of undocumented immigrants counted in the 1980 census developed by Warren and Passel, *op. cit.*, and Passel and Woodrow, *op. cit.*, include data by period of entry as well as age and sex. These various assumptions about the number of undocumented immigrants presented in 1970 and 1960 are based on this distribution by period of entry and correspond to the assumptions about numbers present in 1980.

⁹ Jeffrey S. Passel, "Undocumented Immigrants: How Many?" *Proceedings of the Social Statistics Section*, 1985, American Statistical Association, Washington, DC, pp. 65-72.

in the "other races" category in published 1980 census data; in previous censuses and in vital statistics, such responses were almost always coded into the "White" category.

In another change in the 1980 census, "Asian Indian" was added as a separate response category to the race question. This category is included in the "Asian and Pacific Islander" grouping or the "other races" category in 1980 census tabulations. However, in past censuses and in vital statistics through 1978, persons of Asian Indian descent were classified as "White." This group numbered about 362,000 in 1980, but was much smaller, probably less than 100,000, in 1970.

Because of the need for comparability between the racial groupings in the population as estimated from demographic analysis and as classified in the census, either the estimated population or the census population must be modified to conform to the other. Since the data do not exist for modifying the estimated population, it has been necessary to redistribute 1980 census data to conform to the historical categories of the estimates. The modification involves the reassignment of race based on detailed cross-tabulations of race and Hispanic origin from the sample and complete-count census data.¹² The modification procedures distribute the persons originally in the "other (not specified)" race category to three modified race groups: White, Black, and Other (consisting of American Indian, Alaska Native, Asian, and Pacific Islander). Persons of "other (not specified)" race and Hispanic origin are reassigned to either White or Black race. All persons of "other (not specified)" race and Mexican origin are reassigned as White; within each of the remaining Hispanic origin categories (Puerto Rican, Cuban, Other Spanish), the reassessments are primarily to White, but also to Black. Persons of "other (not specified)" race and not of Hispanic origin are distributed to all three modified race groups—White, Black, and other races. All computations are carried out within race, origin, sex, and age categories at the county level and aggregated to the national level.

The modification of the racial data in the 1980 census added 6.3 million persons, or 3.4 percent, to the White category and 188,000 persons, or 0.7 percent, to the Black population; the other-races census category decreased by 6.5 million (55.9 percent). (See table 2.2.) The estimates of undercount as derived by demographic analysis given in this report are consistent with the racial groupings of the modified census data rather than the original census data as compiled and published in the standard census reports; unless otherwise noted, all census figures and measures derived from census data are based on the modified racial groups. Because most of the reclassification involved persons of White and other races, the White population and the other-races population are often combined in the presentation of results, i.e., coverage rates are shown for the White-and-other races population and for the Black population. Detailed 1980 census data based on modified race categories are shown in appendix B.

2.B.3. LIMITATIONS OF DEMOGRAPHIC ANALYSIS

The estimates resulting from the application of demographic analysis provide measures of net underenumeration in the census. Net underenumeration represents the combined effect of omissions from the census, erroneous inclusions in the census (including duplications), and reporting errors in the census (for age, sex, and race/Hispanic origin categories). Because demographic analysis works with aggregated data both from the census and independent data sources, it cannot separate the components of net underenumeration. Matching studies, such as the PEP or the Content Reinterview Survey¹³ that use individual records from the census and a survey, can address separately the various components of census error. The quality of the measures of undercount from demographic analysis is obviously a function of the

quality of the independent population estimates. Inconsistencies between reporting of race in the census and reporting of race in the components of the population estimates and other errors in the estimation of the population will be included in the demographic estimate of undercount.

The relative sizes of estimates of coverage errors among demographic groups derived with demographic analysis are extremely robust with regard to possible errors in the underlying assumptions and to reasonable alternative assumptions because the same data elements are generally used in construction of the estimates for most demographic subgroups. The robustness extends to sex differences in coverage within age-race groups, age differences within race-sex groups, and race differences. Estimates of coverage differences among the censuses of 1940-1980 are also extremely robust with regard to possible errors in the assumptions.¹⁴

The potential effect on the overall demographic estimate of census coverage of an error in any of the assumptions on which demographic analysis must rely is small, in general. The principal exceptions to this statement are assumptions relating to the magnitude of the undocumented immigrant population. A number of memoranda in the Census Bureau's PERM series include detailed discussions of the effect of potential errors in the demographic estimates of the population on the estimates of net census undercount. (See appendix C.) Interested readers may obtain copies of the relevant memoranda and papers by requesting them from the authors.

Ideally, a confidence interval could provide an assessment of the quality of the demographic estimate of census coverage. Such a confidence interval could also be used to assess the relative quality of

¹² The modification procedure is described in detail in Jeffrey S. Passel, "Procedures for Producing Preliminary OMB-Consistent Modified Race Data from the 1980 Census by Age, Sex, and Hispanic Origin for States and Counties," U.S. Bureau of the Census, 1982 (unpublished).

¹³For a description of the 1980 Content Reinterview Survey, see U.S. Bureau of the Census, *Census of Population and Housing: 1980, Evaluation and Research Reports, PHC80-E2, "Content Reinterview Study: Accuracy of Data for Selected Population and Housing Characteristics as Measured by Reinterview,"* Washington, DC, 1986.

¹⁴ An example of the robustness of the coverage estimates among demographic groups to differences in underlying assumptions can be found by comparing the preliminary and revised estimates of coverage for 1980 and 1970. (See table 2.1.) For both years, a large number of revisions and changes in the data and assumptions were made in the development of the revised estimates, yet the relative difference in the coverage estimates for males and females and for Blacks and White-and-other races remained essentially the same. For further discussion of the robustness of the coverage estimates for 1980 to alternative assumptions regarding the size of the undocumented immigrant population, see section 3.C of chapter 3.

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alternative estimates from demographic analysis and the PEP or to combine statistically estimates from the two sources. Unfortunately, the complex nature of the demographic estimate and its lack of reliance on sample data make the construction of a confidence interval virtually impossible using

conventional statistical techniques. The Census Bureau is pursuing research to provide an assessment of the probable range of error in the estimates, a concept similar to a statistical confidence interval. This work relies on the judgment of experts

to assess the potential error in each demographic component. The components would then be combined with computer simulations to provide a distribution for the demographic estimate of population in 1980 and census undercount. (References are provided in appendix C.)

Table 2.1. Comparison of Initial and Revised Estimates of Net Undercount of the Legally Resident Population Based on Demographic Analysis, by Sex and Race: 1980 and 1970

(Base of percents is estimated population. A minus sign denotes an estimated net overcount)

Sex and race	1980		1970		
	Initial estimate ¹ (Feb. 1982)	Revised estimate ² (Sept. 1985)	Initial estimate ³ (Feb. 1974)	Revised estimates	
Percent net undercount					
Total population	0.5	1.0	2.5	2.2	2.6
Male.....	1.5	2.0	3.3	3.1	3.3
Female	-0.4	-	1.8	1.4	1.8
Black	5.3	5.6	7.7	7.6	7.7
White-and-other races	-0.2	0.3	1.8	1.5	1.9
Difference					
Male: female	1.9	2.0	1.5	1.7	1.5
Black: White-and-other races	5.5	5.3	5.9	6.1	5.8

- Represents zero or rounds to zero.

Note: Estimates pertain to the legally resident population. (See section 2.B.)

¹Estimates published in U.S. Bureau of the Census, *Current Population Reports*, Series P-23, No. 115, "Coverage of the National Population in the 1980 Census by Age, Sex, and Race: Preliminary Estimates by Demographic Analysis," by Jeffrey S. Passel, Jacob S. Siegel, and J. Gregory Robinson, Washington, DC, 1982.

²Estimates published in this report. Revisions include: (1) substitution of final data covering 1978-1980 for provisional data on births, deaths, and immigrants, (2) use of aggregate Medicare data from 1980 for estimating the population aged 65 and over in 1980, (3) use of new estimates of births for estimating the White population aged 45 to 64 in 1980, (4) adjustments of data on net legal immigration.

³Estimates published in U.S. Bureau of the Census, *Census of Population and Housing: 1970, Evaluation and Research Program*, PHC(E)-4, "Estimates of Coverage of Population by Sex, Race, and Age: Demographic Analysis," by Jacob S. Siegel, Washington, DC, 1974

⁴Revisions include: (1) adjustment of data on net legal immigration, especially the emigration component, (2) use of new estimates of the population aged 65 and over in 1970. The revised estimates were published in U.S. Bureau of the Census, *Current Population Reports*, Series P-23, No. 115, op.cit.

⁵Estimates published in this report. Additional revisions include: (1) use of new estimates of births for estimating the White population aged 35 to 54 in 1970, (2) adjustments of data on net legal immigration, particularly the racial groupings, (3) use of aggregate Medicare data from 1980 for estimating the population aged 55 and over in 1970.

Table 2.2. Modified and Original Race Groups From the 1980 Census

Race group	Modified race group	Original race group	Difference	
			Amount	Percent
All races	226,545,805	226,545,805	-	-
White	194,712,563	188,371,622	+6,340,941	+3.4
Black	26,683,414	26,495,025	+188,389	+0.7
Other races.....	5,149,828	11,679,158	-6,529,330	-55.9
Other specified ¹	5,149,828	4,920,839	+228,989	+4.7
Other, not specified	(X)	6,758,319	-6,758,319	-100.0

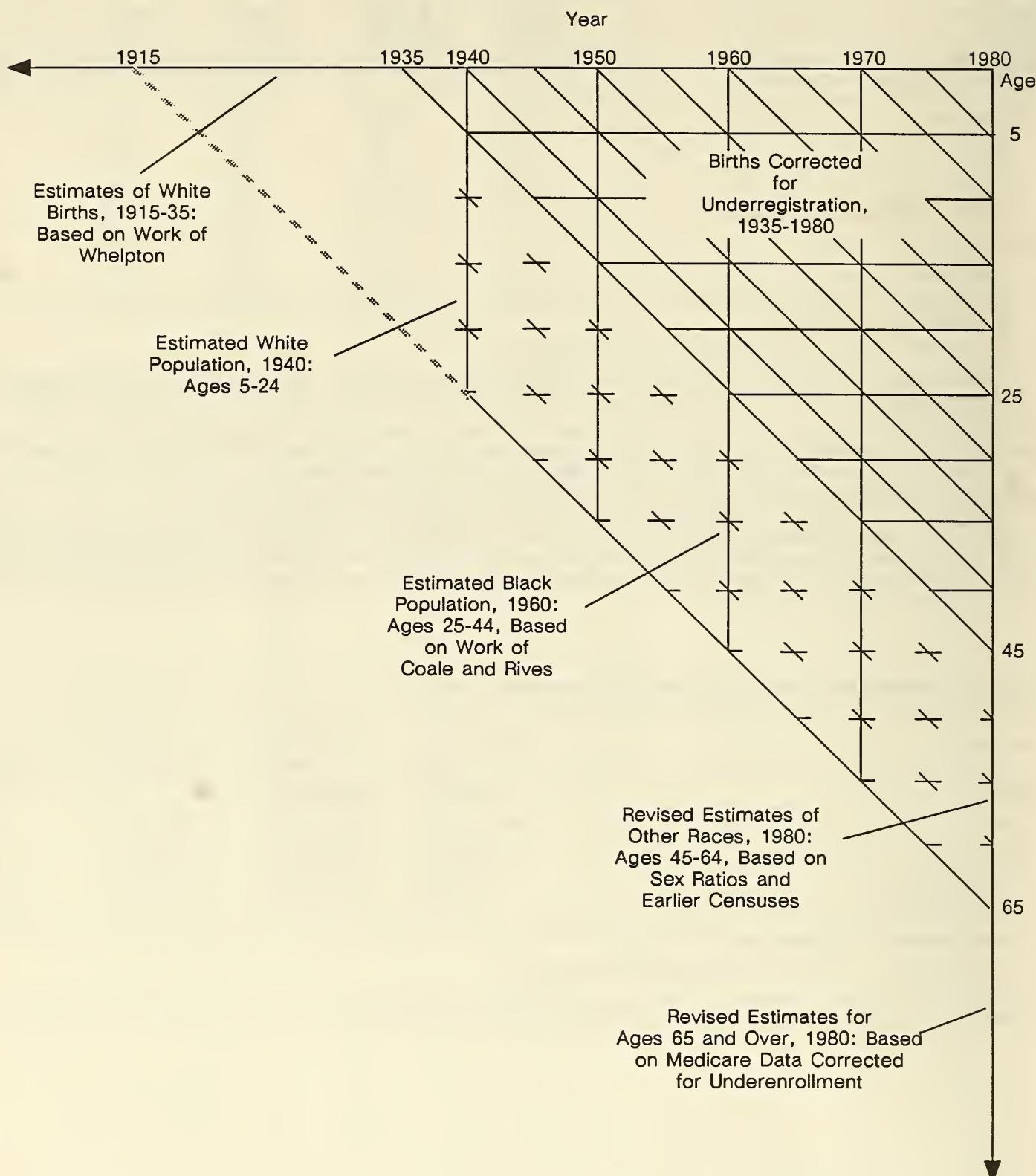
(X) Not applicable. - Represents zero or rounds to zero.

¹Includes Asian and Pacific Islander, American Indian, and Alaska Native.

Source: Jeffrey S. Passel, "Procedures for Producing Preliminary OMB-Consistent Modified Race Data from the 1980 Census by Age, Sex, and Hispanic Origin for States and Counties," U.S. Bureau of the Census, 1982 (unpublished).

Figure 2.1

Lexis Diagram Showing Construction of Revised Demographic Analysis Estimates of Census Coverage for 1980



Chapter 3.—Results of Demographic Analysis

3.A. COVERAGE OF THE 1980 CENSUS RELATIVE TO THE 1970 CENSUS

One assessment of the quality of the 1980 census can be obtained by comparing the census count in 1980 with an estimate based on the 1970 census count plus estimates of intercensal population change between 1970 and 1980 from data on births, deaths, and net immigration.¹ The difference between the 1980 census count and the estimate for 1980 based on the 1970 census is known as the "error of closure." Error of closure represents the relative coverage of the two censuses. A positive error of closure indicates that the 1980 census had better coverage, i.e., it missed fewer people, than the 1970 census; a negative error of closure indicates that the 1970 census was better.

In computing the error of closure, it is not necessary to know the coverage of the 1970 census, but the estimated components of change during the decade must

¹A number of terms are used in this report to refer to the immigration component of population change. Net legal immigration and net legal civilian immigration refer to the sum of the following components: aliens admitted for permanent residence, refugees, net movement of civilian citizens, net movement (or migration) from Puerto Rico, emigration of native-born persons, emigration of legal foreign-born residents, and net change in the foreign student population. (See appendix C for references about definitions and derivations of the separate components.) Legal immigration or legal civilian migration refers to the first two of the components only, which account for the largest portion of net legal immigration. Undocumented immigration is used to refer to the net flow of undocumented immigrants into and out of the country. Net immigration or net civilian immigration refers to net legal immigration plus net undocumented immigration. Net immigration, sometimes also called immigration, is thus all components of population change other than births, deaths, and net movement of the military overseas. Any other terms referring to the immigration component or nonstandard usages of these defined terms are clarified in the text.

be extremely accurate. Because of uncertainties surrounding the magnitude of undocumented immigration during the 1970-1980 decade, this component is not explicitly included in the measurement of population change between 1970 and 1980² shown below. The contribution of undocumented immigration to changes in census coverage will be considered later in this section in assessing the relative accuracy of the 1970 and 1980 censuses, however.

Estimated intercensal population change from 1970 to 1980 based on the best estimates of births, deaths, and net *legal* immigration is 18,092,000. The difference between the two census counts is much greater—23,244,000.

The details of the calculation are:

1970 census.....	203,302,000
Births (corrected for underregistration).....	+ 33,543,000
Deaths.....	- 19,324,000
Net legal civilian immigration.....	+ 3,297,000
Net military movement to U.S.	+ 574,000
Net increase.....	+ 18,092,000
1980 estimate based on	
1970 census	221,393,000
1980 census	226,546,000
Difference of 1980 census from estimate (error of closure)	+ 5,152,000

These figures indicate that the 1980 census count is 5,152,000 greater than expected on the basis of the 1970 census count, i.e., that the error of closure is 5,152,000, or 2.3 percent of the 1980 census count. The 1970-1980 error of

²Most references in this chapter to time intervals for demographic components, e.g., 1970 to 1980, mean from April 1 of the initial year through March 31 the final year. April 1 of any year ending in zero is "Census Day" for 1930-1980.

closure is much larger than in previous decades. The 1960-1970 error of closure is 781,000, or only 0.4 percent of the ending census, and the 1950-1960 error of closure is 887,000, or 0.5 percent.

One interpretation of the 1970-1980 error of closure is that the 1980 census missed 5.15 million fewer people than the 1970 census. However, because the error of closure calculation shown above does not take into account undocumented immigration between 1970 and 1980, the error of closure overstates the improvement in coverage in 1980. As we will show, the 1980 census does represent an improvement over the 1970 census even when undocumented immigration is taken into account.

There are several possible explanations for the large error of closure between the 1970 and 1980 censuses. First, as noted earlier, the 1980 census included an estimated 2.06 million undocumented immigrants.³ Since no allowance was made for this group in the estimates of immigration used to compute the error of closure, the undocumented immigrants counted in the 1980 census would be included as part of the initial estimate of the error of closure, at least to the extent that the undocumented immigrants did not appear in the 1970 census. Since our research shows no evidence of undocumented immigrants being counted in the 1970 census, the full 2.06 million counted in 1980 erroneously contributes to the error of closure. Subtracting this figure reduces the "unexplained" error of closure to 3.1 million.

³Robert Warren and Jeffrey S. Passel, "A Count of the Uncountable: Estimates of Undocumented Aliens Counted in the 1980 United States Census," *Demography*, Vol. 24, No. 3 (August 1987), pp. 375-393; Jeffrey S. Passel and Karen A. Woodrow, "Geographic Distribution of Undocumented Immigrants: Estimates of Undocumented Aliens Counted in the 1980 Census by State," *International Migration Review*, Vol. 18 (Fall 1984), pp. 642-671.

A second factor that can explain the error of closure for the 1980 and 1970 censuses is that coverage of the 1980 census is better than for 1970; i.e., omission rates of most age-sex-race categories are lower in 1980 than the corresponding rates in 1970. In other words, many people who were not counted in the 1970 census were counted in 1980. This factor is the commonly accepted interpretation of error of closure.

A third possible explanation for all or part of the unexplained error of closure is the presence of duplications and erroneous enumerations in the 1980 census. Duplications are persons who are counted more than once in the census. An erroneous enumeration occurs when a person who should not have been counted is counted. Examples of such erroneous enumerations are persons born after Census Day (April 1, 1980), persons who died before Census Day, and nonresidents of the United States. Duplications and erroneous enumerations increase the error of closure to the extent that the latter census (1980 in this case) has more of them than the earlier census (1970). Finally, errors in the estimated components of change could account for part of the error of closure.

It may never be possible to explain fully the 1970-1980 error of closure because of the limited amount of information available on the 1970 census, in particular. On the basis of the Census Bureau's research, it is possible to make some assessments of the relative contributions of these various factors to the 1970-1980 error of closure, however. First, as noted, about 2.06 million of the 5.15 million error of closure can be attributed to undocumented immigrants being counted in the 1980 census. Other principal components of intercensal population change—births, deaths, and legal immigration—are thought to be accurate, so that errors in measurement of these components would contribute relatively little to the error of closure.

An evaluation of housing unit duplication in the 1980 census⁴ found that between

1.6 million and 2.5 million persons were enumerated in duplicated housing units. The PEP itself yielded an estimate of 2.5 million duplicates.⁵ These estimates of duplications, taken in combination with the allowance for undocumented immigrants, imply that the improvement in coverage in the 1980 census (i.e., the reduction in net persons missed) amounted to at least 0.6 to 1.5 million persons.⁶ However, this comparison assumes that there were no duplications in the 1970 census. Although we do not have accurate measures of duplications in 1970, it is reasonable to assume that some did occur (although the available evidence suggests more duplications in 1980 than 1970). Also, the PEP estimates for 1980 probably underestimate duplications. Thus, the actual reduction in persons missed in 1980 is probably *understated* by this comparison. Finally, it should be noted that errors in the estimates of any of the factors discussed could alter the assessment of their relative contributions to the error of closure. In any case, under most reasonable scenarios, the 1980 census had significantly better coverage than the 1970 census.

3.B. ALTERNATIVE ESTIMATES OF COVERAGE OF THE 1980 CENSUS

Estimates of coverage of the 1980 census are derived by comparing the census count with the independent estimate of the population derived with demographic analysis, as described in chapter 2, especially equations 2.B.1, 2.B.5, and 2.B.7. Since the current discussion relates to the total population, inconsistencies in the definition of race between the independent demographic estimate and the census count are of no concern. However, the number of undocumented immigrants actually in the population and the number included in the estimate are major determinants of the estimated level of coverage. Accordingly, this section discusses various alternative

estimates of coverage that incorporate a range of estimates of the undocumented immigrant population. (Detailed estimates of population and undercount from demographic analysis are shown in appendix A; detailed census data in appendix B.)

3.B.1. Assumptions Underlying Alternative Estimates

Although the total number of undocumented immigrants *living*⁷ in the United States in 1980 is not known, various studies, including a number of research projects done at the Census Bureau, have served to narrow the range of reasonable alternatives considerably. The figure with the strongest empirical basis has already been cited—the estimated 2.06 million undocumented immigrants who were included in the 1980 census.⁸ As will be shown, this estimate can be used in conjunction with the independent estimates to measure coverage of the "legally resident population." (See also Section 2.B.1. Undocumented Immigrants.)

Table 3.1 presents five sets of alternative estimates of coverage of the 1980 census for the total population and the population by sex and by race. The estimates differ solely with respect to the assumptions about the number of undocumented immigrants included in the estimated population. For each different assumption, estimates for the 1970 census consistent with the 1980 estimates are shown. The first estimate represents coverage of the legally resident population in 1980. The estimated legally resident population (226,717,000), which includes no allowance for undocumented residents, is compared to an "estimated legally resident" census figure. The census figure used for comparison is 224,489,000. It

⁴U.S. Bureau of the Census, 1980 Census Preliminary Results Memorandum No. 44, "1980 Decennial Census Housing Unit Enumeration Duplication Study—Results," by James L. O'Brien and T. Christopher Dyke, 1982 (unpublished).

⁵0.6 million = 5.15 million error of closure minus 2.06 million undocumented residents minus 2.5 million duplicates; and 1.5 million = 5.15 million error of closure minus 2.06 million undocumented residents minus 1.6 million duplicates.

⁷The number of undocumented aliens in the country at a given time and the number *living* in the country at the same time could be quite different. It is possible for an undocumented alien to be in the United States and working, but be a resident of another country because his or her "usual residence" is in the foreign country. See Jeffrey S. Passel, "Undocumented Immigrants: How Many?" *Proceedings of the Social Statistics Section*, 1985, American Statistical Association, Washington, DC, pp. 65-72.

⁸See note 3.

represents legal residents counted, estimated by subtracting the number of undocumented immigrants counted in the census (2.06 million) from the actual census count.⁹ (See equation 2.B.7.)

The remaining estimates in table 3.1 are estimates of coverage of the *total* resident population. The 1980 census figure used for these comparisons is the total number of persons enumerated (226,546,000). In these estimates, the populations derived by demographic analysis include an explicit allowance for undocumented immigration, a figure which is added to the estimated legally resident population. (See equation 2.B.5.) In order to encompass a reasonable range which is likely to include the true figure for the undocumented immigrant population of the United States in 1980, the estimates vary from a low of 2.06 million undocumented immigrants (i.e., the number estimated to have been counted in the census) to an upper limit of 5 million. For 1960 and 1970, estimates of undocumented residents at the time corresponding to the 2.06 to 5 million range are based on the distribution by period of entry for the undocumented immigrants counted in the 1980 census.¹⁰

The choice of 2 to 5 million as a range for the undocumented immigrant population is based on research done at the Census Bureau and elsewhere. Central to this work is the estimate of undocumented immigrants counted in the 1980 census. This estimate has been used in conjunction with other estimates and data, notably Mexican census data, to draw inferences about the total number of undocumented immigrants in the country in 1980. Although the available evidence is not conclusive, it points to a range of 2.5 to 3.5 million for

the number of undocumented immigrants residing in the United States in 1980.¹¹ This range is encompassed by the range suggested by the National Academy of Sciences' Panel on Immigration Statistics which concluded that the number probably fell between 2 million and 4 million.¹² (See also basic sources cited in appendix C.)

3.B.2. Alternative Estimates of Coverage for 1980 and 1970

For the legally resident population, the estimated undercount in 1980 is 1.0 percent or 2,227,000 persons. This figure represents a substantial improvement in coverage over the 1970 census, which is estimated to have missed 2.6 percent of the legal residents, or 5,323,000 persons. The difference between these two figures—3,095,000—represents improvement in net coverage (or error of closure) of legal residents, i.e., the difference between any decrease in the number of omissions in 1980 over 1970 and any increase in duplications and erroneous inclusions in 1980 over 1970.

The alternative estimates of coverage of the *total* resident population reveal the same picture—the 1980 census had lower levels of undercount than the 1970 census, even if there were as many as 5 million undocumented immigrants living in the country in 1980. At the lower end of the range of estimates, the net undercount in 1980 was 1.0 percent, or 2,227,000, if the number of undocumented immigrants in the country is assumed to be equal to the number counted in the 1980 census.

The corresponding figure for 1970 is an

undercount of 2.8 percent, or 5,863,000.¹³ If 5 million undocumented immigrants were in the country in 1980, the estimated undercount in 1980 was 5,171,000, or 2.2 percent. This estimate is lower in terms of both the number of persons missed and the percentage undercount than the best figure for 1970—the undercount of legal residents at 5,323,000, or 2.6 percent. The estimate for 1970 that corresponds to 5 million undocumented immigrants in 1980 is an undercount of 6,636,000 or 3.2 percent.¹⁴ Even at this level of undocumented immigration, the coverage of the 1980 census is estimated to have improved by 0.9 percentage points, or 1,465,000 persons.

For 1980, estimates of the net undercount rate vary from 1.0 percent, on the assumption that there were 2.06 million undocumented immigrants in the country, to 2.2 percent, on the assumption that there were 5 million. The corresponding

¹³Note that the figure for 1980 is the same as the net undercount for the legally resident population, by definition. To estimate coverage of the legally resident population, the number of undocumented immigrants counted is subtracted from the census figure; for coverage estimates of the total resident population, the same number of undocumented immigrants is added to the estimated size of the legally resident population; that is:

$$\text{Under-count of legal residents} = \text{Estimate of legal residents} - [\text{Census count} - \text{Undocumented immigrants counted}]$$

and

$$\text{Under-count of total population} = [\text{Estimate of legal residents} + \text{Undocumented immigrants counted}] - \text{Census count}$$

The lowest assumption for 1970 that includes an allowance for undocumented immigrants in the country in 1970 is an undercount of 5,863,000 or 2.8 percent. Unlike the estimates for 1980, this figure exceeds the estimated undercount for legal residents in 1970. The allowances for undocumented immigrants in the country in 1970 are based on information from the 1980 census on undocumented immigrants counted in 1980 who entered the country before 1970. Attempts to estimate the number of undocumented immigrants counted in the 1970 census suggest that no undocumented immigrants were counted in that census. Consequently, the coverage estimates for legal residents in 1970 differ from the estimates with a minimal allowance for undocumented immigration.

¹⁴See note 10 for an explanation of the derivation of the number of undocumented immigrants in the country in 1960 and 1970 corresponding to the alternative assumptions for 1980.

⁹Note that for 1970 the total census count and the census count of legal residents are the same. Application of the methods used by Warren and Passel, *op. cit.*, to the 1970 census does not produce evidence that detectable numbers of undocumented immigrants were counted in 1970.

¹⁰The estimates of the undocumented population in 1960 and 1970 are derived by using the estimated number counted in 1980 who entered before 1960 and 1970, respectively. These figures are inflated by the same factor used to arrive at the corresponding total for 1980; e.g., the estimate for 1970 corresponding to 5 million undocumented immigrants in 1980 is (5/2.06) times the estimated number of undocumented immigrants counted in 1980 who entered the United States before 1970.

¹¹Jeffrey S. Passel, "Undocumented Immigrants: How Many?" *op. cit.*

¹²National Research Council, National Academy of Sciences, *Immigration Statistics: A Story of Neglect*, Report of the Panel on Immigration Statistics, Daniel B. Levine, Kenneth Hill, and Robert Warren (editors), National Academy Press: Washington, DC, 1985. See especially, Appendix A, "Illegal Aliens: An Assessment," by Kenneth Hill.

estimates for 1970 range from 2.8 percent to 3.2 percent. There is no overlap in the ranges. Note that there is a direct relationship between the assumptions regarding the number of undocumented immigrants in the country in 1980 and the net undercount as estimated by demographic analysis. Every additional 1 million undocumented immigrants assumed to be living in the country in 1980 adds 1 million to the estimated undercount, or approximately 0.4 percent.

Table 3.2 gives some historical perspective to the undercount estimates for 1980 by displaying a consistently defined set of undercount estimates for the resident population, by race and sex, covering the censuses of 1940 through 1980. The estimates shown include an allowance for 3 million undocumented immigrants in 1980 and correspondingly smaller allowances in 1970 and 1960. As also shown in table 3.1, the 1980 census represents a substantial improvement in coverage over the 1970 census, with reduction in undercount of 2,940,000 persons, or 1.5 percentage points. This amount and percentage of improvement in coverage represents a much greater degree of improvement than in any other recent census. The improvement between 1960 and 1970 was only 46,000 persons or 0.4 percentage points; between 1950 and 1960, 835,000 or 1.1 percentage points; and between 1940 and 1950, 905,000 or 1.2 percentage points. Similar patterns occur with other allowances for undocumented immigration; in particular, the estimates for 1940, 1950, and 1960 are essentially unaffected by estimates of undocumented residents, virtually all of whom entered the United States between 1960 and 1980.

3.C. ESTIMATES OF NET CENSUS UNDERENUMERATION BY SEX, RACE, AND AGE

3.C.1. Selection of a Set of Estimates for Discussion

Tables 3.1 and 3.2 show that the pattern of broad improvements in coverage over time noted previously for the total population occurs across all major race-sex groups. The reductions in undercount for race-sex groups between 1970 and 1980 are considerably greater than improvements that

occurred in previous decades. Again, improvements are noted under the various assumptions about undocumented immigration, although assumptions of larger numbers of undocumented immigrants imply somewhat lesser improvements over the 1970-1980 decade.

Undercount rates for Blacks in 1980 were lower than in 1970; again there is no overlap, as the rates range from 5.6 to 6.5 percent in 1980 versus 7.7 to 8.2 percent in 1970. Rates for White-and-other races were also lower in 1980, with a range from 0.3 to 1.6 percent in 1980 versus 1.9 to 2.5 percent in 1970. Undercount rates decreased for males and for females. As the assumed number of undocumented immigrants is increased, the magnitude of the improvement from 1970 to 1980 lessens somewhat, with the effect on White-and-other races being greater than the effect on Blacks. Nonetheless, the nature of the change in coverage between 1970 and 1980 as measured by demographic analysis is generally the same regardless of the assumed number of undocumented residents in 1980.

In the remainder of the section, the discussion focuses on the details of the coverage estimates—undercount rates by age, sex, and race, as well as changes over time. Since the general results are the same regardless of which set of estimates is chosen, we select a single set of estimates to simplify and clarify the discussion of the results. The sole difference among the various sets of estimates is the assumed number of undocumented immigrants in the country. Accordingly, choosing among the estimates means specifying an assumption about the number of undocumented immigrants in the country in 1980.

As discussed previously, the exact size of the undocumented immigrant population in 1980 is one of the great demographic mysteries in the United States. Over the past several years, however, there has been a consensus emerging among analysts in the field that the numbers are much smaller than the early conjectural estimates suggested, i.e., much smaller than the 6 to 12 million range that was popular in the 1970s. As noted earlier, a range of 2 to 4 million undocumented residents in 1980 was suggested by the National Academy of Sciences' panel on Immigration Statistics.¹⁵ This range is consistent with research conducted at the

Census Bureau on the number of undocumented immigrants included in the 1980 census and on the number missed by the census.¹⁶ (See also material cited in appendix C.)

For discussion purposes, we select the set of estimates that falls in the middle of the range of estimates of undocumented immigrants—the undercount estimates based on the assumption that there were 3 million undocumented immigrants in the country in 1980. This estimate, added to the estimated legally resident population of 226,717,000 for 1980, gives an estimate for the total resident population of 229,717,000. This population figure implies an undercount of 1.4 percent in 1980 and 2.9 percent in 1970. The findings about coverage of the 1980 census and earlier censuses described in the following sections are generally not affected by assumptions about undocumented immigration. The specific levels of undercount are a function of the assumed numbers of undocumented immigrants, but the relationships among various demographic subgroups are generally not. When this assumption does affect a statement, it will be noted. Detailed estimates of net underenumeration for all sets of demographic estimates are shown in appendix A.

3.C.2. Estimates of Coverage for Sex and Race Groups

The overall undercount in the 1980 census is largely attributable to the undercount of males. (See tables 3.2 and 3.1.) Males were undercounted in 1980 at a rate of 2.4 percent, i.e., 2,675,000 males were missed in the census. The rate of undercoverage for females was considerably less, only 0.4 percent, as was the number of females missed, 496,000.¹⁷ About 84 percent of the persons missed in 1980 were males. (Under the highest assumption of 5 million undocumented immigrants in 1980, about 72 percent were

¹⁶See notes 3 and 11.

¹⁷The coverage difference of 2.0 percentage points between the undercount rate of males (2.4 percent) and females (0.4 percent) is extremely robust with regard to alternative assumptions about the size of the undocumented alien population. The coverage difference ranges narrowly from 1.9 percentage points under an assumption of 2.06 million undocumented residents in 1980 to 2.1 percentage points under the assumption of 5 million undocumented residents.

¹⁵See note 12.

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male.) These figures represent a considerable increase from the 62 percent male in 1970 and 57 percent in 1960 among persons missed.

The increased concentration of undercount among males in 1980 arises from a greater reduction in undercoverage between 1970 and 1980 for females. The undercount of females was reduced by 1,807,000 persons, while the rate of undercount decreased by 1.8 percentage points. For males, the reduction in undercount was less—1,132,000—as was the reduction in undercount rate—1.3 percentage points.

Figure 3.1 displays graphically the amount of undercount by sex over the last five censuses. The number of females missed has been reduced steadily from one census to the next. For males, the number missed changed little between 1950 and 1970, but was reduced somewhat in 1980. The difference between the number of males missed and the number of females was relatively constant for the censuses of 1940, 1950, and 1960 at somewhat less than 1 million persons. Since 1960, however, the difference between the sexes in amount of census undercount has increased to over three times the difference in 1940. This increasing difference between the sexes in census coverage coincides with the historical reduction in the number of missed dwelling units and the increased reliance on mail returns. It appears that as the number of missed units has declined, a greater proportion of persons missed are in units where some people have been counted.¹⁸

¹⁸In 1950, it was estimated that almost three-quarters (73 percent) of missed persons were not counted because they lived in a missed dwelling unit. The proportion in missed units declined to 60 percent in 1960 and to about one-half (50 percent) of all omissions in 1970. Thus, in 1970, one-half of all omissions were the result of missed units and one-half were the result of persons missed in covered housing units. Although comparable data for 1980 are not available, the proportion of omissions caused by missed units and missed persons in enumerated units may have been about the same as in 1970. For a discussion of the coverage of housing units and type of coverage error, see U.S. Bureau of the Census, *The Post-Enumeration Survey: 1950*, Technical Paper No. 4, Washington, DC, 1960, p. 5-9; U.S. Bureau of the Census, *Current Population Reports*, Series P-23, No. 56, "Coverage of Population in the 1970 Census and Some Implications for Public Programs," by Jacob S. Siegel, Washington, DC, 1975, p. 9-10; and U.S. Bureau of the Census, *Census of Population and Housing*:

These within-covered-unit omissions are apparently persons whose attachment to the household is weaker or less clear; such persons would tend to be males. The same general pattern of differences between the sexes is shown by the percentages of undercount in figure 3.2.

As in previous censuses, the Black population experienced a much higher rate of undercount in 1980 than did the White-and-other-races population—1,669,000 Blacks, or 5.9 percent of the Black population, were missed in 1980 as compared with 1,501,000 persons or only 0.7 percent of the White-and-other-races population (table 3.2). The percentage point reduction in undercount rates between 1970 and 1980 was greater for Blacks (a 2.1 percentage-point reduction from 8.0 to 5.9 percent) than for the White-and-other-races population (a 1.5 point reduction from 2.2 percent to 0.7 percent). The greater degree of improvement for Blacks reduced the coverage difference between the race groups slightly from 5.8 to 5.2 percentage points.¹⁹

Figure 3.4 shows the steady improvements in coverage from 1940 through 1980 for each race. The net undercount rates have improved in each census for the total, the White-and-other-races, and the Black populations. However, the percentage-point improvements from one census to the next have been roughly the same for the racial groups. Thus, the percentage-point difference in coverage between the Black and the White-and-other-races populations have remained roughly constant over the last five censuses, varying between 5.2 and 5.8 percentage points.

Figure 3.3 shows another important aspect of racial differences in census coverage—the number of persons missed. For the White-and-other-races population, each

successive census has missed fewer persons.²⁰ For Blacks, however, the number of persons missed has remained roughly constant, falling between 1.5 and 2.0 million in each of the five censuses. (In fact, the number increased slightly from 1940 through 1970 and then fell in 1980.) The rate of undercount for Blacks has fallen steadily, not because fewer Blacks have been missed, but because their total number has increased over time. As a result, the difference between the races in the number of persons missed has decreased sharply over time.

The Black population has accounted for a growing share of the overall undercount. Under the assumption of 3 million undocumented residents in 1980, the 1980 census represents the first time in the last five censuses that the number of Blacks missed exceeded the number of persons of White-and-other races who were missed, as Blacks accounted for 53 percent of the total number of persons missed. The proportion Black in 1980 among the missed population is somewhat smaller under other assumptions—42 percent with 4 million undocumented residents and 36 percent with 5 million—but the proportion is still larger than in previous censuses. In 1970, Blacks represented 32 percent of the total undercount; in 1960, 28 percent; in 1950, 23 percent; and in 1940, only 19 percent.

For both race groups, improvements in coverage between 1970 and 1980 were greater for females than for males. (See table 3.2.) Coverage of Black females was improved by a substantial 2.5 percentage points to a 3.1 percent undercount in 1980. The undercount rate of Black males remained high in 1980—8.8 percent. Yet, the 1.8 point reduction in the rate from 1970 (10.6 percent) was significant when compared to the small gains in coverage over 1940-1970. For the White-and-other-races population, coverage of females improved by 1.7 percentage points to an undercount of essentially zero in 1980; White-and-other

1980, *Evaluation and Research Reports*, PHC80-E1, "The Coverage of Housing in the 1980 Census," Washington, DC, 1985.

¹⁹The 5.2 percentage point difference in the undercount rates of Blacks (5.9 percent) and White-and-other races (0.7 percent) in the 1980 census is also extremely robust with regard to the assumed number of undocumented aliens. The difference ranges from 5.3 percentage points under an assumption of 2.06 million undocumented residents in 1980 to 4.9 percentage points under the assumption of 5 million undocumented residents.

²⁰One minor exception to this statement occurs with the assumption of 5 million undocumented immigrants in 1980 and the corresponding assumptions for 1960 and 1970. Under this assumption, the 1960 census missed 4.5 million persons and the 1970 census, 4.6 million.

races males recorded a 1.3 percentage point improvement, to lower their undercount to 1.5 percent in 1980.

3.C.3. Age Patterns of Census Coverage for the Black Population

The undercounts and rates for Blacks in the 1980 census in table 3.3 show that a disproportionate share of the omissions occurred among children under 5 years of age and males aged 20 to 59 years. The highest undercounts in 1970 occurred in basically these same age groups. (See table 3.4 and figures 3.5 and 3.6) As would be expected, the undercount rates for children in 1980 are approximately the same for both sexes. Both males and females have high undercounts at ages under 5 years (9.6 and 9.0 percent for males and females, respectively), moderate undercounts at ages 5 to 9 years, small undercounts at ages 10 to 14 years, and negligible undercounts or overcounts at ages 15 to 19 years.

For ages 20 to 64 years, Black males have rather high undercount rates, with the rates from ages 25 to 54 exceeding 12 percent. For ages 40 to 49 years, the rates reach 18 percent. On the other hand, Black females aged 20 to 64 years have low to moderate undercount rates, ranging from 0.4 to 5.8 percent. For both sexes at ages 65 to 74 years, Blacks show small to moderate net overcounts. Such overcounts tend to occur as a result of age misreporting into these age groups.

Net undercount rates for Blacks in 1980 are smaller than in 1970 for all age-sex groups except for males aged 40 to 59 years and 75 years and over and for females aged 40 to 44 years. (See table 3.4 and figures 3.5 and 3.6.) The greatest concentrated improvements occurred among Black males aged 15 to 34 years; over this age range, coverage rates improved an average of 5.1 percentage points. Many of the coverage improvement activities in the 1980 census were aimed specifically at these age groups; they apparently succeeded to some extent. However, even with the improvements, the undercount rates for Black males aged 20 to 34 years remained high. Black females in the same age groups, 15 to 34 years, also showed substantial improvements in coverage over 1970, averaging 4.0 percentage points.

The pattern of improvement between 1970 and 1980 for Blacks in the middle and older ages is somewhat irregular. For Black males, the age groups 60 to 74 years showed a moderate reduction in undercount rates, ranging from 1.0 to 3.4 percentage points. For ages 75 years and over, coverage worsened slightly, by 1.8 percentage points. Black females, however, showed large improvements for ages 55 to 64 years and 70 to 74 years, but only moderate improvements for ages 65 to 69 years and ages 75 and over. In assessing the significance of these changes, it should be borne in mind that differences in net undercount between the 1970 and 1980 censuses reflect changes in age misreporting as well as changes in net omissions.

The age groups that had the smallest improvements in coverage among Blacks were children under 10 years of age, males aged 40 to 59 years, and females aged 35 to 49 years. The lack of improvement in coverage for Black children is particularly puzzling. In 1970, the high undercount for Black children was attributed, in part, to insufficient space on the census form for listing all persons in large households, together with incomplete follow-up activities for such forms on the part of enumerators.²¹ In 1980, several coverage improvement activities were designed to prevent the recurrence of this particular problem. Although we cannot say how well these coverage

improvement activities were performed in 1980, it is clear that some factors remained which tended to lead to omissions of Black children.

3.C.4. Age Patterns of Census Coverage for the White-and-Other-Races Population

Because of the very high level of census coverage (and low levels of undercoverage) for the White-and-other-races population, the age pattern of undercount rates is much less variable than for the Black population. (See table 3.3 and figures 3.7 and 3.8.) According to the estimates in table 3.3, White-and-other-races females have undercount rates of less than 1 percent for all age groups up to age 75; only for ages 75 years and older does the undercount rate for White-and-other-races females exceed 1 percent (2.6 percent). For White-and-other-races males, the age pattern of undercount is quite similar to the pattern of Black males, but at much lower levels of undercount. In the age range 20 to 64 years, White-and-other-races males show moderate undercoverage rates—1.7 to 3.0 percent. For all other ages, the undercounts are less than 1 percent.

A large majority of the *net* undercount for persons of White-and-other races is attributable to males aged 20 to 64 years. About 90 percent of the net omissions occurred in this group if 3 million undocumented aliens are assumed; over 70 percent with 4 million; and over 60 percent with 5 million. Although the Black population has a similar pattern of undercoverage, the higher level of Black undercount means that the concentration is less. About 59 percent of *net* omissions for Blacks occurred to males aged 20 to 64 years under the assumption of 3 million undocumented aliens; 58 percent with 4 million; and 56 percent with 5 million.

Coverage improved substantially for the White-and-other-races population between 1970 and 1980, also. All age-sex groups for the White-and-other-races population had lower undercount rates in 1980 than in 1970. (See table 3.4 and figures 3.7 and 3.8.) The greatest reductions were for males over age 65 and females over age 55. The average reduction in undercount rate for all ages exceeded 1 percentage point. Figures 3.7 and 3.8 portray the

²¹The short form of the census questionnaire used in the 1970 census provided space for eight persons and the long form provided space for seven persons. Some respondents with large families, particularly in areas where the census was conducted by mail, apparently failed to indicate there were more persons in the household than could be listed on a single questionnaire. In other cases, respondents who correctly noted the need for an additional form were not contacted by enumerators to provide information for the additional persons. Even when the additional persons were counted, there were some instances in which the continuation sheet, or second questionnaire, failed to record the serial number correctly. In such cases, the sheets were not matched to the original form and some children listed on the continuation sheets were not counted as children. See U.S. Bureau of the Census, *Census of Population and Housing: 1970, Evaluation and Research Program, PHC(E)-4, "Estimates of Coverage of Population by Sex, Race, and Age: Demographic Analysis"* by Jacob S. Siegel, Washington, DC, 1974, pg.7.

1970 and 1980 undercount rates graphically. The improvements are readily observed in these figures because the undercount curves for 1980 are always below the corresponding curves for 1970.

3.C.5. Age, Race, and Sex Differences in Census Coverage Over Time

Figures 3.9 and 3.10 which compare the undercount rates by age for the four race-sex groups in the 1980 and 1970 censuses, respectively, portray a remarkable similarity from one census to the next. With the exception of only a few age groups, each curve tends to fall entirely below the curve for the group with the next highest undercount rate. In each census, the pattern is the same. From high to low undercount rates, the groups are: Black males, Black females, White-and-other-races males, and White-and-other-races females. The major exceptions are at the older ages where apparently the net coverage rates are affected by age misreporting more among Blacks than among the White-and-other-races population.

Sex ratios provide another tool that can be used to assess relative, but not

absolute, levels of coverage of the sexes.²² The ratio of males to females in the estimated population by age, is virtually insensitive to moderate levels of error in estimating components of change. As such, expected sex ratios, i.e., the sex ratios in the estimated population, provided an extremely robust measure for assessing relative undercoverage of males and females.²³ If the expected sex ratio for an age group exceeds the census sex ratio, then males in the age group have a higher undercount rate than females. If the census sex ratio exceeds the expected sex ratio, the females have a higher undercount rate than males. If the sex ratios are equal, then the undercount rates are the same.

For all age groups from 20 to 69, the expected sex ratios for Blacks in 1980 exceed the census sex ratios. (See figure

3.11.) For ages between 25 and 54 years, the differences generally exceed 10 points, implying that Black male undercount rates in these ages exceed the rates for females by at least 10 percentage points. For ages under 20 years and over 70 years, the expected sex ratios and census sex ratios are very nearly equal. At these ages, Black males and females have nearly the same undercount rates.

The differences between expected and census sex ratios for White-and-other races in 1980 are much smaller than for Blacks. (See figure 3.12.) The sex ratios are nearly the same for ages under 20 and over 65 years. Between 20 and 64 years, the expected sex ratios are 2 to 3 points higher than the census sex ratios. These are the ages in which male undercount rates exceed those for females.

For 1970, the age patterns of expected sex ratios are much less regular because of the large number of males who were overseas in the military at the time. Nonetheless, the overall picture of sex differences portrayed by the sex ratios is similar to 1980. For Blacks, expected sex ratios exceed census sex ratios up to age 70, with the largest differences occurring between 20 and 54 years of age. (See figure 3.13.) For White-and-other races, the sex ratios are very nearly equal at most ages. The differences that do occur, about 2 to 3 points, are at ages 20 to 54 years, also. (See figure 3.14.)

²²Sex ratios also provide a basis for comparing alternative estimates of coverage. The sex ratios from the PEP are compared with those from demographic analysis and the census in chapter 8.

²³The robustness of expected sex ratios extends to the effect of alternative assumptions regarding undocumented immigration. There are virtually no differences in the expected sex ratios for any of the alternative sets of demographic estimates.

Table 3.1. Alternative Estimates of the Amount and Percent of Net Underenumeration, by Sex and by Race: 1980 and 1970

(Numbers in thousands. Base of percents is estimated population. See text for explanation of alternative estimates)

Alternative estimates and race or sex	1980				1970		
	Estimated population	Modified census count ¹	Net undercount		Estimated population	Net undercount	
			Amount	Percent		Amount	Percent
Total population							
Legal residents	226,717	224,489	2,227	1.0	208,625	5,323	2.6
Total residents							
Counted undocumented aliens ²	228,773	226,546	2,227	1.0	209,165	5,863	2.8
3 million undocumented aliens	229,717	226,546	3,171	1.4	209,413	6,111	2.9
4 million undocumented aliens.....	230,717	226,546	4,171	1.8	209,675	6,373	3.0
5 million undocumented aliens.....	231,717	226,546	5,171	2.2	209,938	6,636	3.2
Male							
Legal residents	111,132	108,959	2,173	2.0	102,369	3,410	3.3
Total residents							
Counted undocumented aliens ²	112,226	110,053	2,173	1.9	102,642	3,682	3.6
3 million undocumented aliens.....	112,728	110,053	2,675	2.4	102,767	3,807	3.7
4 million undocumented aliens.....	113,260	110,053	3,207	2.8	102,899	3,940	3.8
5 million undocumented aliens.....	113,792	110,053	3,739	3.3	103,032	4,073	4.0
Female							
Legal residents	115,585	115,530	54	-	106,256	1,913	1.8
Total residents							
Counted undocumented aliens ²	116,547	116,493	54	-	106,524	2,181	2.0
3 million undocumented aliens.....	116,989	116,493	496	0.4	106,646	2,303	2.2
4 million undocumented aliens	117,457	116,493	964	0.8	106,776	2,433	2.3
5 million undocumented aliens	117,925	116,493	1,432	1.2	106,906	2,563	2.4
Black							
Legal residents	28,064	26,486	1,579	5.6	24,472	1,883	7.7
Total residents							
Counted undocumented aliens ²	28,262	26,683	1,579	5.6	24,531	1,942	7.9
3 million undocumented aliens.....	28,353	26,683	1,669	5.9	24,558	1,969	8.0
4 million undocumented aliens	28,449	26,683	1,766	6.2	24,587	1,998	8.1
5 million undocumented aliens	28,545	26,683	1,862	6.5	24,615	2,027	8.2
White-and-other races							
Legal residents	198,652	198,004	649	0.3	184,154	3,440	1.9
Total residents							
Counted undocumented aliens ²	200,511	199,862	649	0.3	184,634	3,921	2.1
3 million undocumented aliens.....	201,364	199,862	1,501	0.7	184,855	4,142	2.2
4 million undocumented aliens	202,268	199,862	2,405	1.2	185,089	4,375	2.4
5 million undocumented aliens	203,171	199,862	3,309	1.6	185,323	4,609	2.5

- Represents zero or rounds to zero.

¹Modification is designed to achieve consistency in race classification of census and estimated population. See text.

²Includes an estimated 2.06 million undocumented aliens counted in the 1980 census. See text.

Table 3.2. Estimates of the Amount and Percent of Net Underenumeration by Race and Sex: 1940 to 1980

(Numbers in thousands. Base of percents is estimated population)

Race and sex	1980		1970		1960		1950		1940	
	Amount	Percent								
All classes.....	3,171	1.4	6,111	2.9	6,157	3.3	6,992	4.4	7,897	5.6
Male	2,675	2.4	3,807	3.7	3,491	3.8	3,772	4.8	4,290	6.1
Female.....	496	0.4	2,303	2.2	2,666	2.8	3,219	4.1	3,607	5.2
Black	1,669	5.9	1,969	8.0	1,710	8.3	1,595	9.6	1,478	10.3
Male	1,213	8.8	1,272	10.6	1,061	10.4	963	11.7	906	12.6
Female.....	456	3.1	697	5.6	649	6.2	632	7.5	573	8.0
White-and-other races	1,501	0.7	4,142	2.2	4,447	2.7	5,397	3.8	6,419	5.1
Male	1,462	1.5	2,536	2.8	2,430	3.0	2,810	4.0	3,384	5.3
Female.....	40	-	1,606	1.7	2,017	2.4	2,587	3.6	3,035	4.9

- Represents zero or rounds to zero.

Note: An allowance for 3 million undocumented residents in 1980 is included in the estimated population. Corresponding (smaller) amounts are included in 1970 and 1960. See text.

Table 3.3. Amount and Percent Net Undercount, by Age, Sex, and Race: 1980

(Populations in thousands. All figures rounded independently. Base of percents is estimated population. A minus sign denotes an estimated net overcount)

Age	Black				White-and-other races			
	Male		Female		Male		Female	
	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent
All ages.....	1,213	8.8	456	3.1	1,462	1.5	40	-
Under 5 years	132	9.6	121	9.0	40	0.6	32	0.5
5-9 years	83	6.1	74	5.6	51	0.7	44	0.6
10-14 years	25	1.8	24	1.7	-8	-0.1	-	-
15-19 years	4	0.3	-2	-0.2	9	0.1	-33	-0.4
20-24 years	129	8.9	42	2.8	194	2.0	-4	-
25-29 years	160	12.7	45	3.5	265	3.0	46	0.5
30-34 years	135	13.4	25	2.4	149	1.9	-43	-0.6
35-39 years	133	16.6	32	3.9	156	2.5	-	-
40-44 years	129	18.5	42	5.8	140	2.7	-4	-0.1
45-49 years	117	18.4	33	4.9	144	2.9	10	0.2
50-54 years	95	15.7	12	1.9	117	2.2	-23	-0.4
55-59 years	57	10.8	10	1.8	117	2.3	-47	-0.9
60-64 years	28	6.7	2	0.4	75	1.7	-22	-0.4
65-69 years	-9	-2.9	-28	-6.6	-11	-0.3	-65	-1.5
70-74 years	-4	-1.8	-8	-2.4	-5	-0.2	-11	-0.3
75 and over	2	0.6	32	6.4	31	0.9	161	2.6

- Represents zero or rounds to zero.

Note: Estimates include an allowance for 3 million undocumented residents in 1980. See text.

Table 3.4. Percent Net Undercount, by Age, Sex, and Race, 1970 and 1980, and Difference Between 1970 and 1980

(Base of percents is estimated population. A minus sign denotes an estimated net overcount. Difference represents 1970 percent minus 1980 percent, computed from rounded figures)

Age	Black						White-and-other races					
	Male			Female			Male			Female		
	1980	1970	Difference	1980	1970	Difference	1980	1970	Difference	1980	1970	Difference
All ages	8.8	10.6	1.8	3.1	5.6	2.5	1.5	2.8	1.3	-	1.7	1.7
0 to 4 years	9.6	10.4	0.8	9.0	9.5	0.5	0.6	2.7	2.1	0.5	2.3	1.8
5 to 9 years	6.1	7.3	1.2	5.6	6.8	1.2	0.7	2.6	1.9	0.6	2.4	1.8
10 to 14 years.....	1.8	3.9	2.1	1.7	3.1	1.4	-0.1	1.3	1.4	-	1.1	1.1
15 to 19 years.....	0.3	4.6	4.3	-0.2	3.7	3.9	0.1	1.4	1.3	-0.4	0.6	1.0
20 to 24 years.....	8.9	12.8	3.9	2.8	5.9	3.1	2.0	2.6	0.6	-	0.9	0.9
25 to 29 years.....	12.7	18.5	5.8	3.5	7.3	3.8	3.0	4.0	1.0	0.5	1.5	1.0
30 to 34 years.....	13.4	20.9	7.5	2.4	7.4	5.0	1.9	3.7	1.8	-0.6	1.1	1.7
35 to 39 years.....	16.6	19.3	2.7	3.9	4.5	0.6	2.5	3.8	1.3	-	1.3	1.3
40 to 44 years.....	18.5	18.2	-0.3	5.8	3.7	-2.1	2.7	3.7	1.0	-0.1	1.0	1.1
45 to 49 years.....	18.4	15.6	-2.8	4.9	5.7	0.8	2.9	4.7	1.8	0.2	1.6	1.4
50 to 54 years.....	15.7	11.8	-3.9	1.9	4.7	2.8	2.2	3.2	1.0	-0.4	0.7	1.1
55 to 59 years.....	10.8	10.2	-0.6	1.8	7.5	5.7	2.3	3.3	1.0	-0.9	2.7	3.6
60 to 64 years.....	6.7	8.9	2.2	0.4	6.2	5.8	1.7	2.1	0.4	-0.4	2.3	2.7
65 to 69 years.....	-2.9	-1.9	1.0	-6.6	-4.9	1.7	-0.3	1.8	2.1	-1.5	1.9	3.4
70 to 75 years.....	-1.8	1.6	3.4	-2.4	4.7	7.1	-0.2	1.1	1.3	-0.3	2.6	2.9
75 and over	0.6	-1.2	-1.8	6.4	7.2	0.8	0.9	3.1	2.2	2.6	5.2	2.6

- Represents zero or rounds to zero.

Note: Estimates include an allowance for 3 million undocumented residents in 1980 and a corresponding (smaller) amount in 1970. See text.

Figure 3.1

Amount of Net Undercount, by Sex: 1940, 1950, 1960, 1970, and 1980

1940	1960	1980
1950	1970	

Net undercount (in millions)

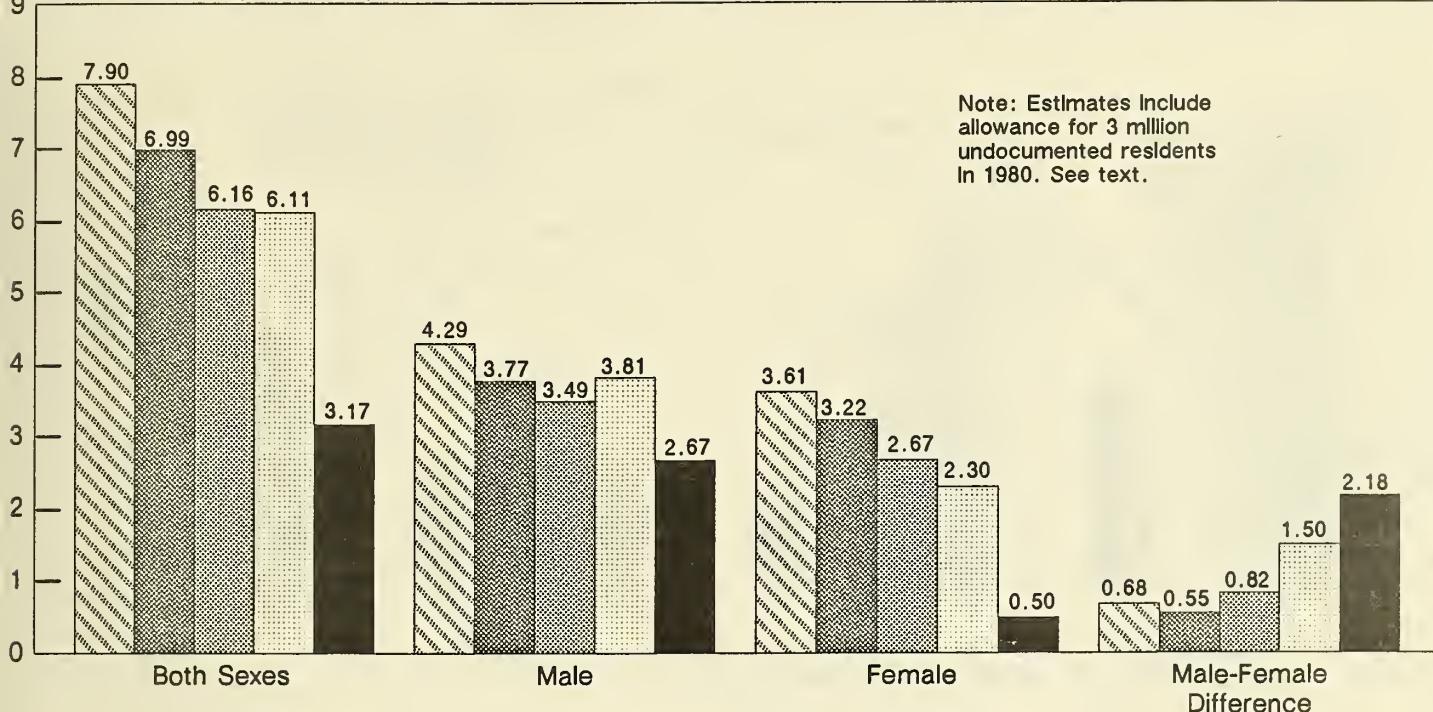


Figure 3.2.

Percent Net Undercount, by Sex: 1940, 1950, 1960, 1970, and 1980

1940	1960	1980
1950	1970	

Percent net undercount

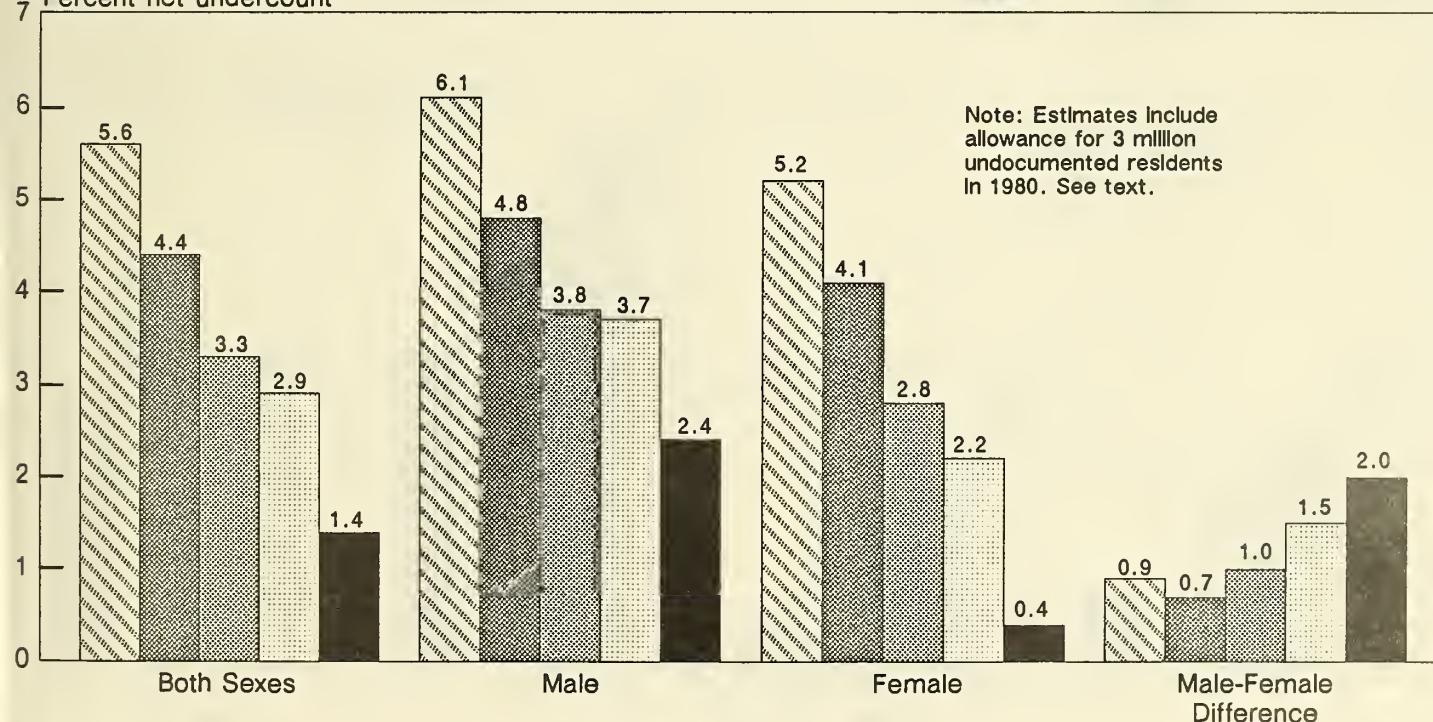


Figure 3.3.
Amount of Net Undercount, by Race: 1940,
1950, 1960, 1970, and 1980

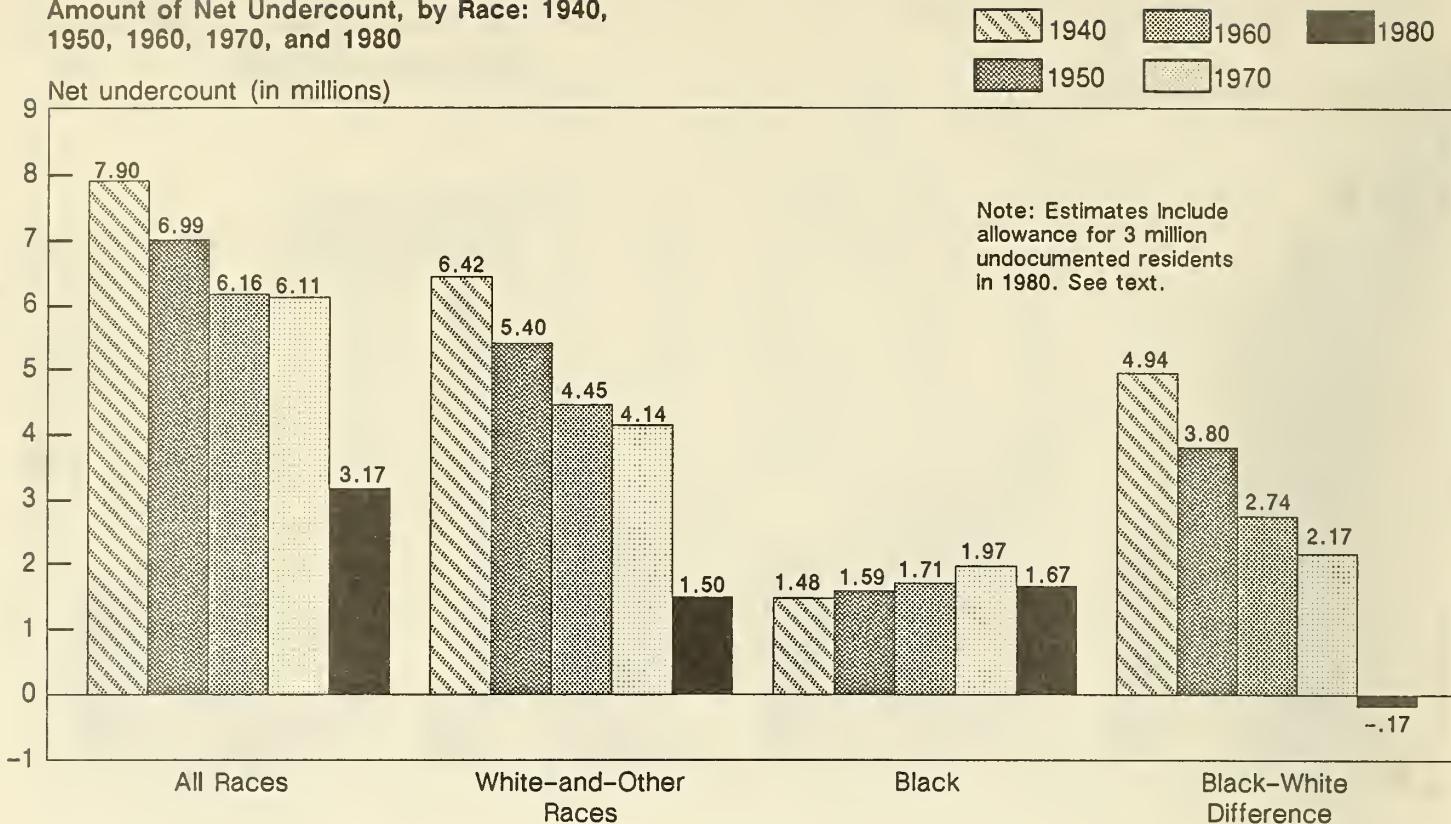


Figure 3.4.
Percent Net Undercount, by Race: 1940,
1950, 1960, 1970, and 1980

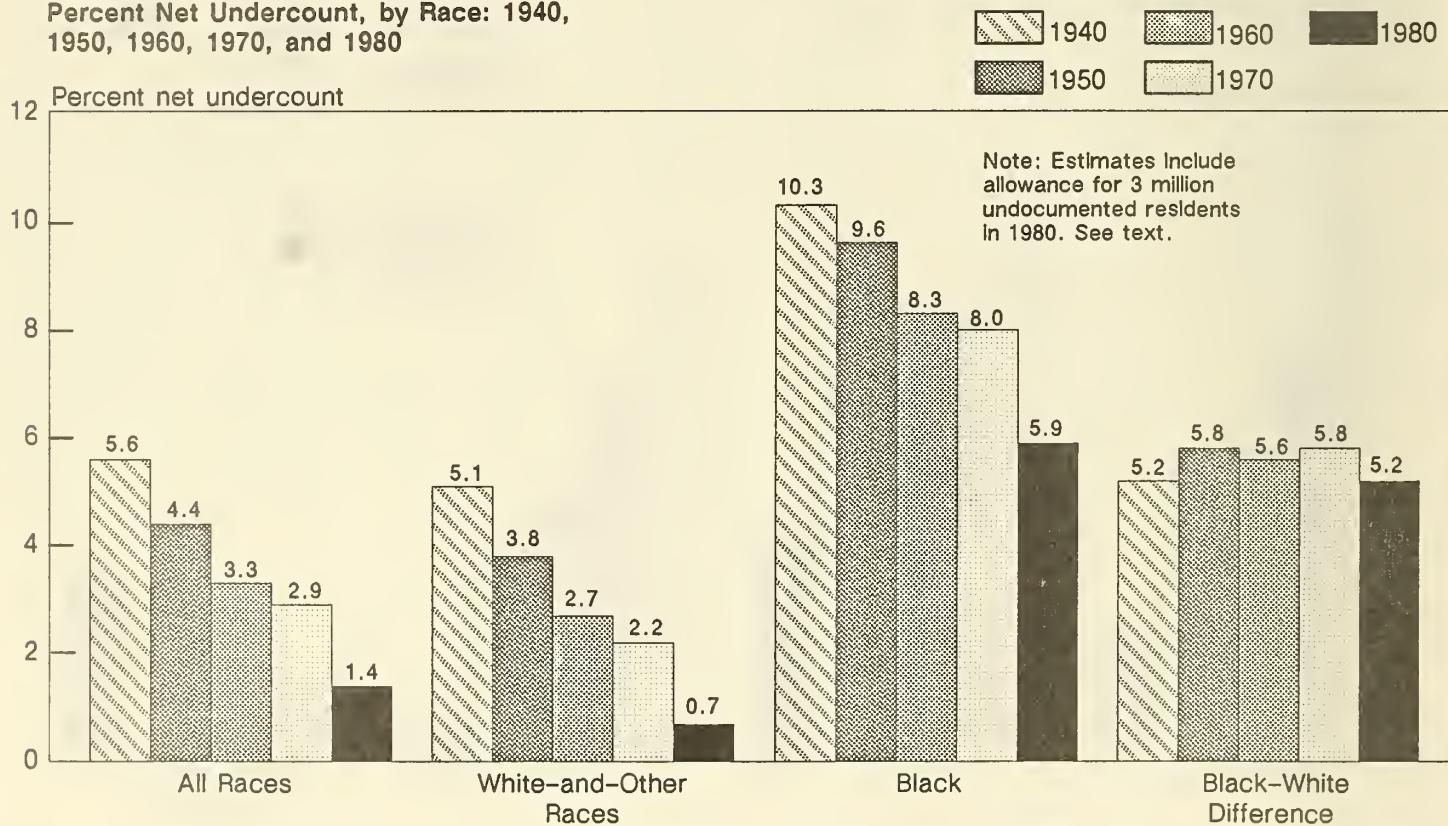


Figure 3.5.
Percent Net Undercount for Black Males, by Age:
1980 and 1970

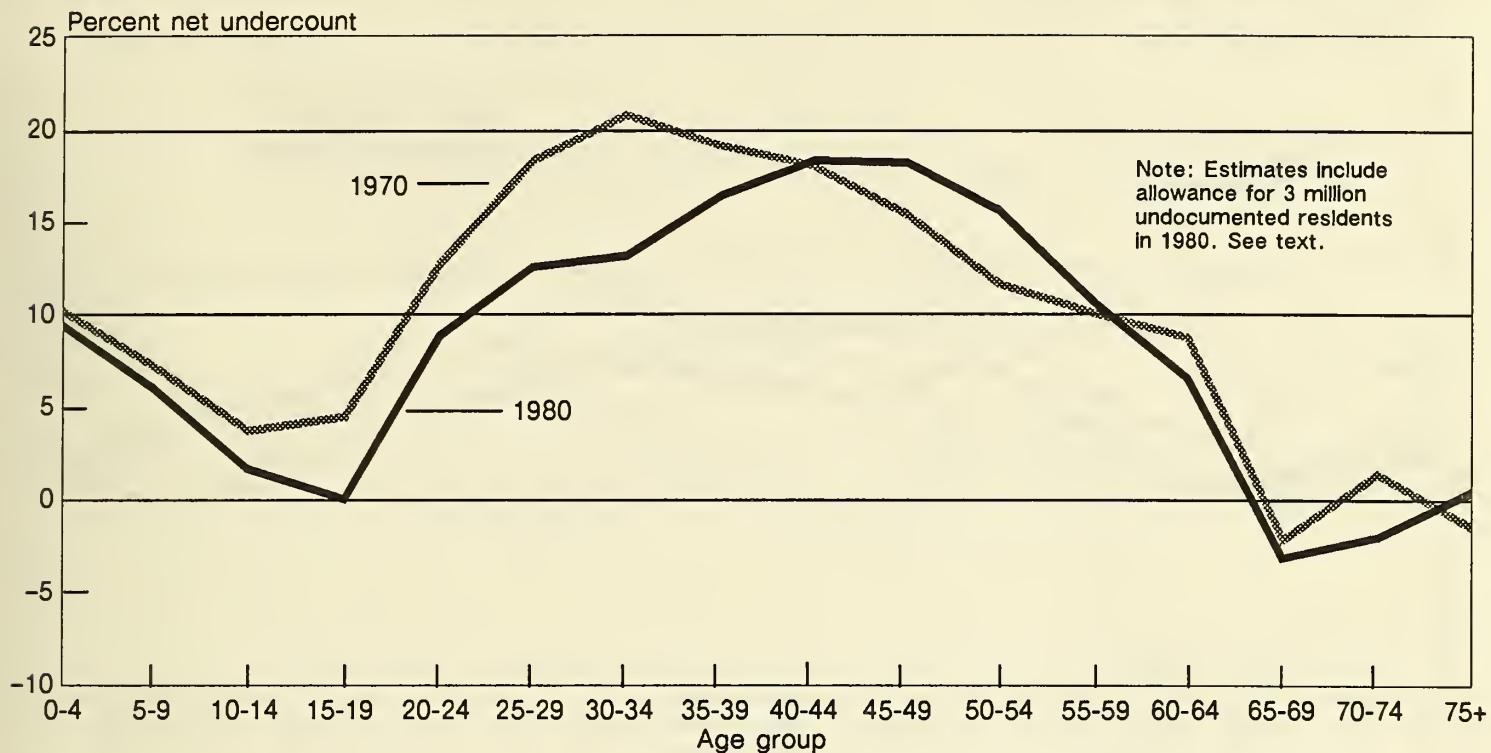


Figure 3.6.
Percent Net Undercount for Black Females, by Age:
1980 and 1970

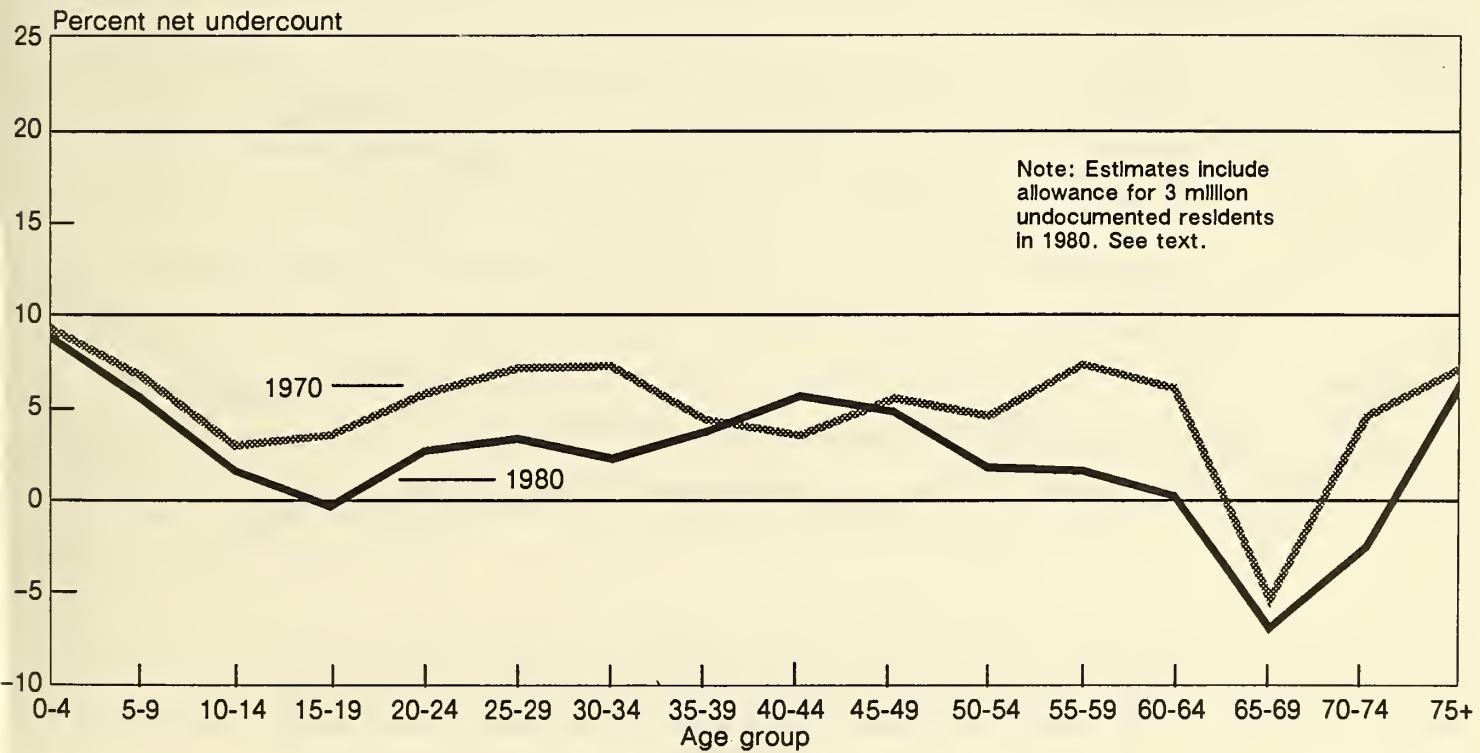


Figure 3.7.
Percent Net Undercount for White-and-Other-Races
Males, by Age: 1980 and 1970

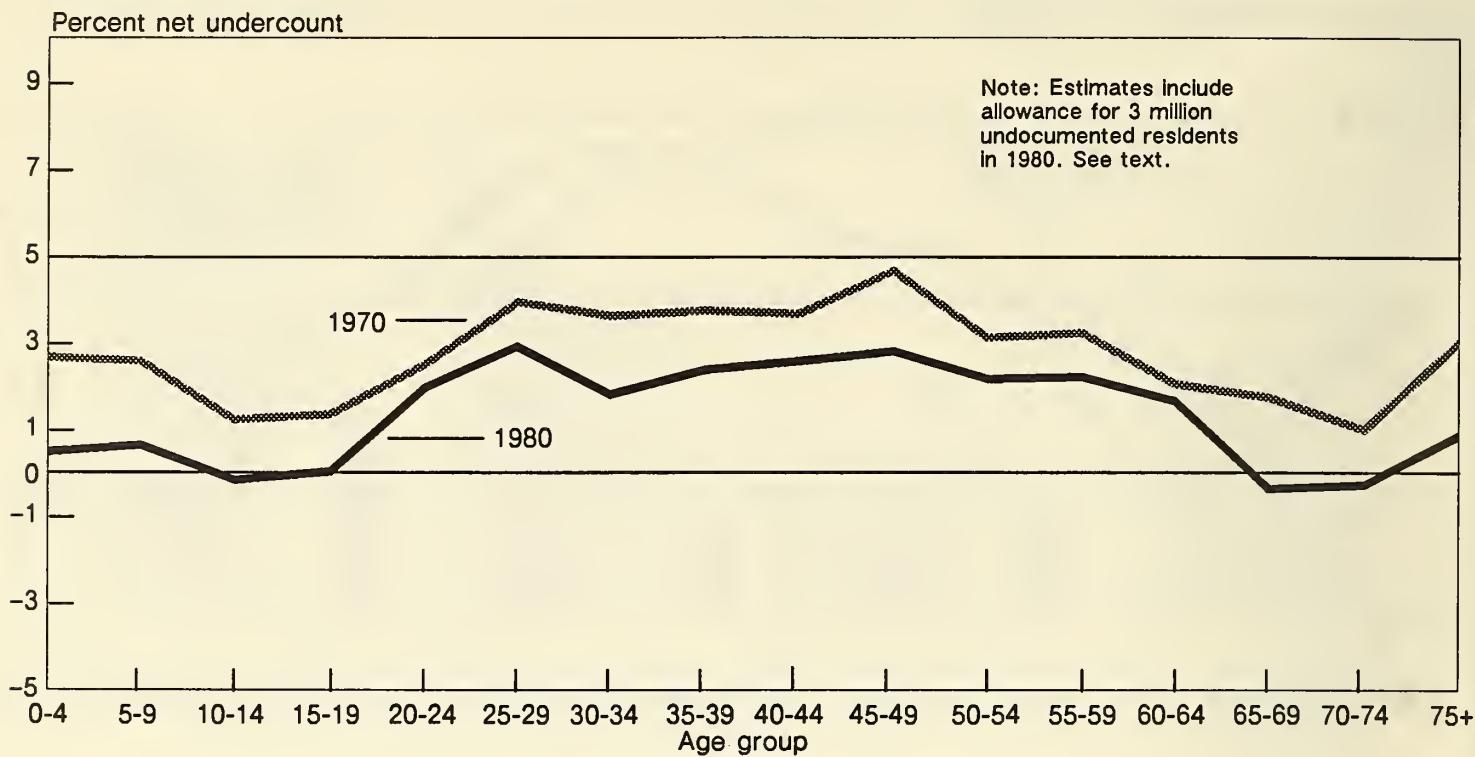


Figure 3.8.
Percent Net Undercount for White-and-Other-Races
Females, by Age: 1980 and 1970

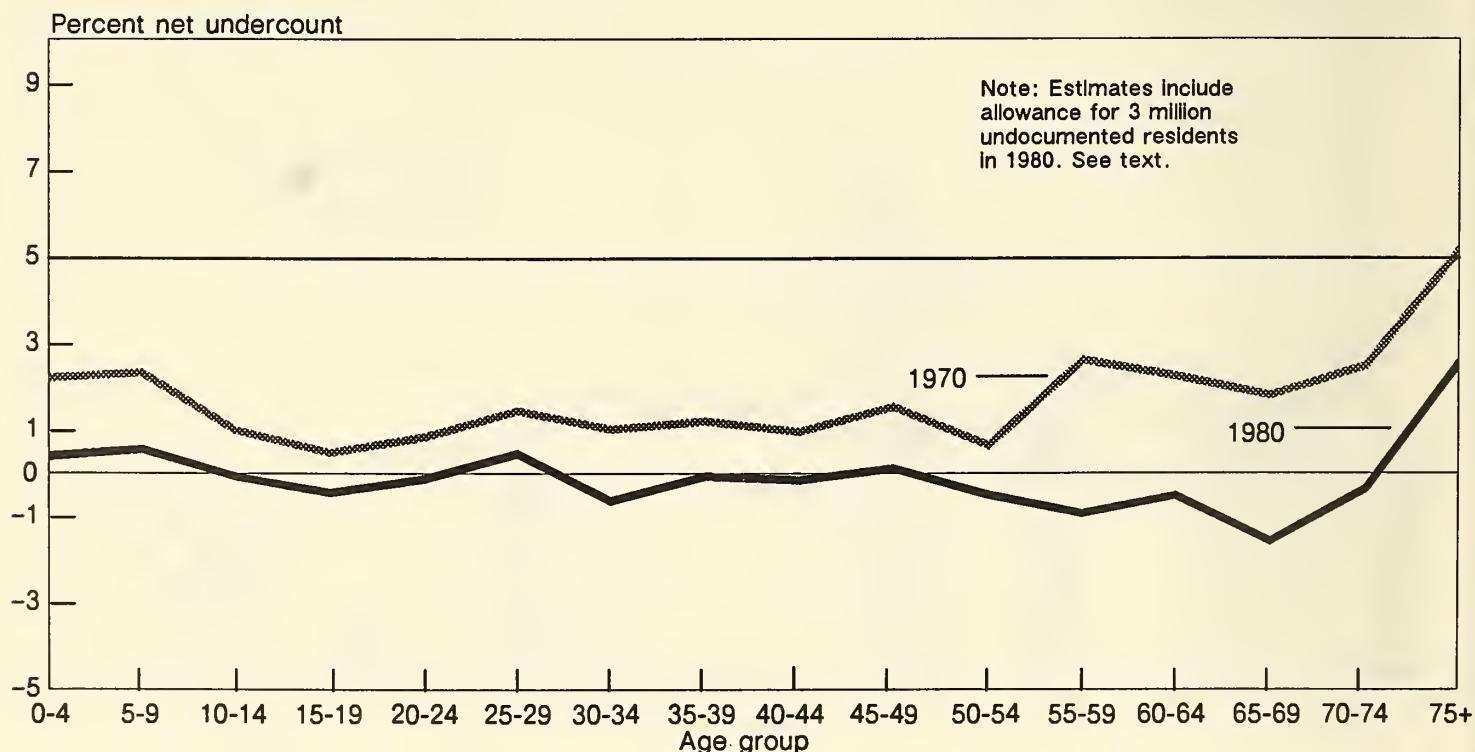


Figure 3.9.
Percent Net Undercount by Age, Race, and Sex: 1980

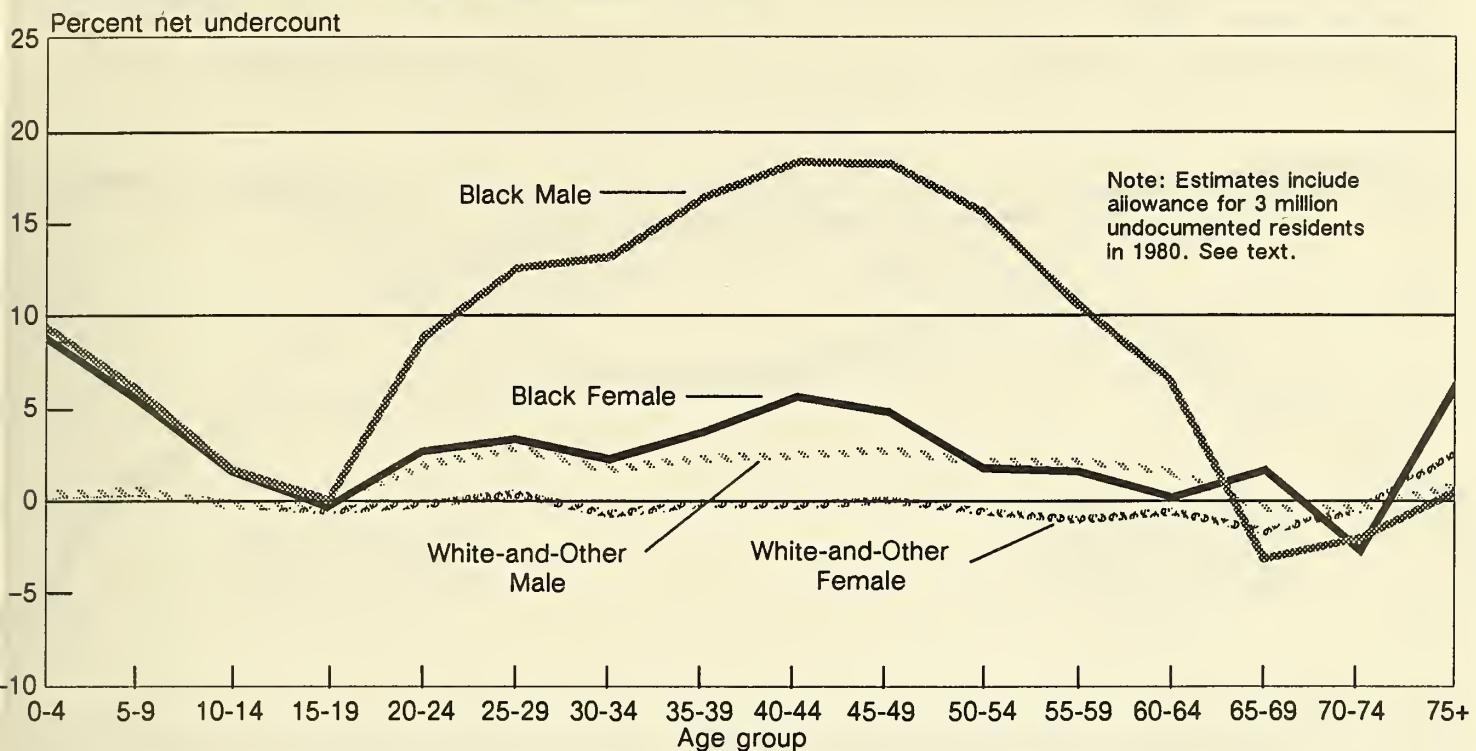


Figure 3.10.
Percent Net Undercount by Age, Race, and Sex: 1970

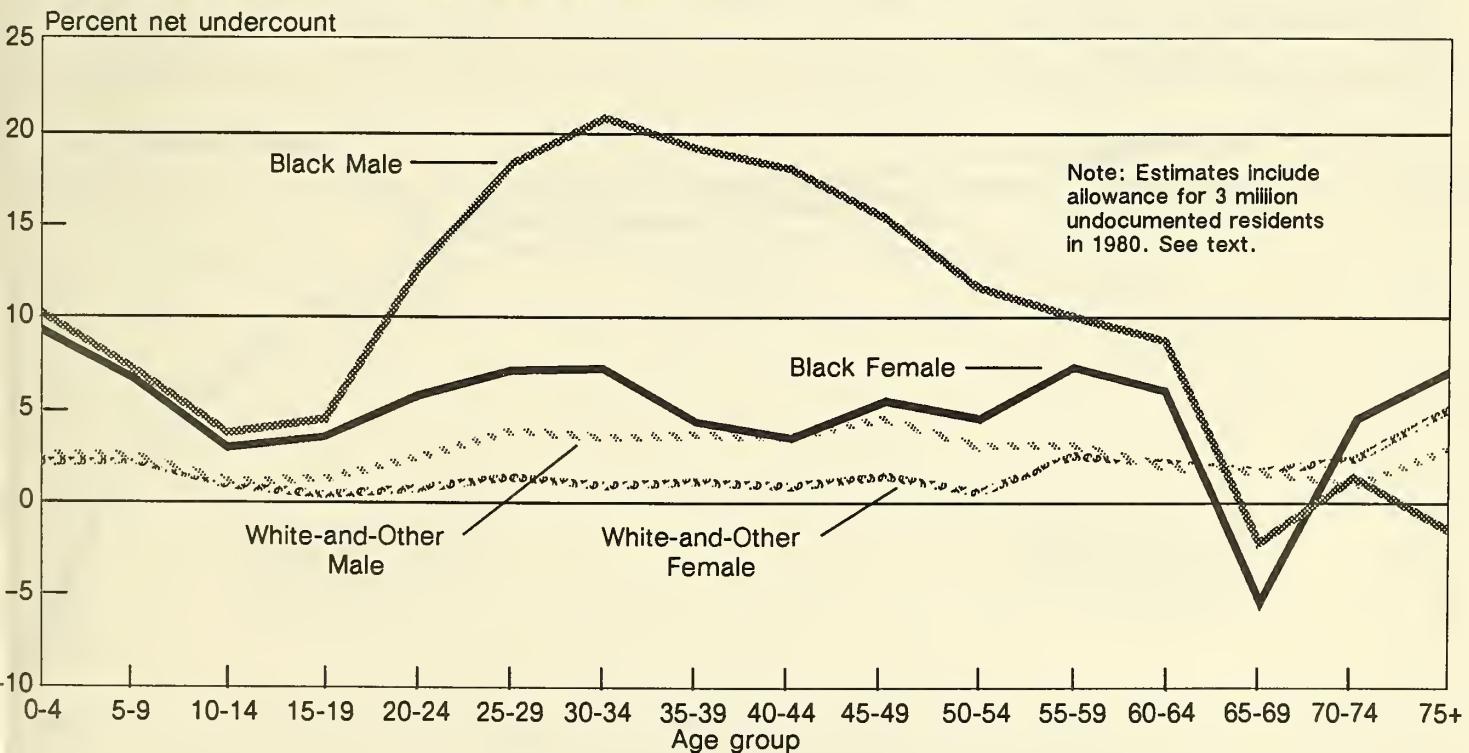


Figure 3.11.
Census Sex Ratios and Expected Sex Ratios for
Blacks, by Age: 1980

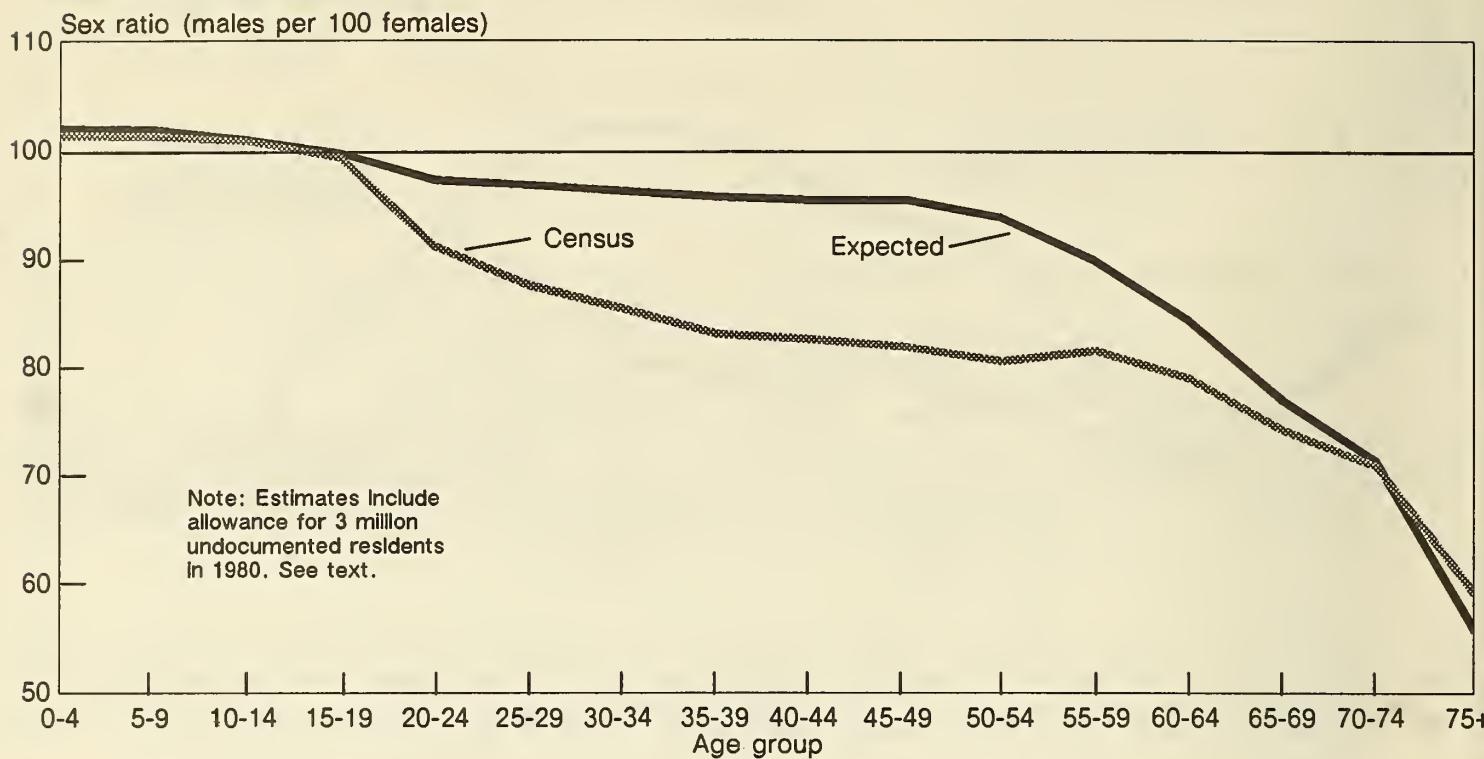


Figure 3.12.
Census Sex Ratios and Expected Sex Ratios for White-
and-Other Races, by Age: 1980

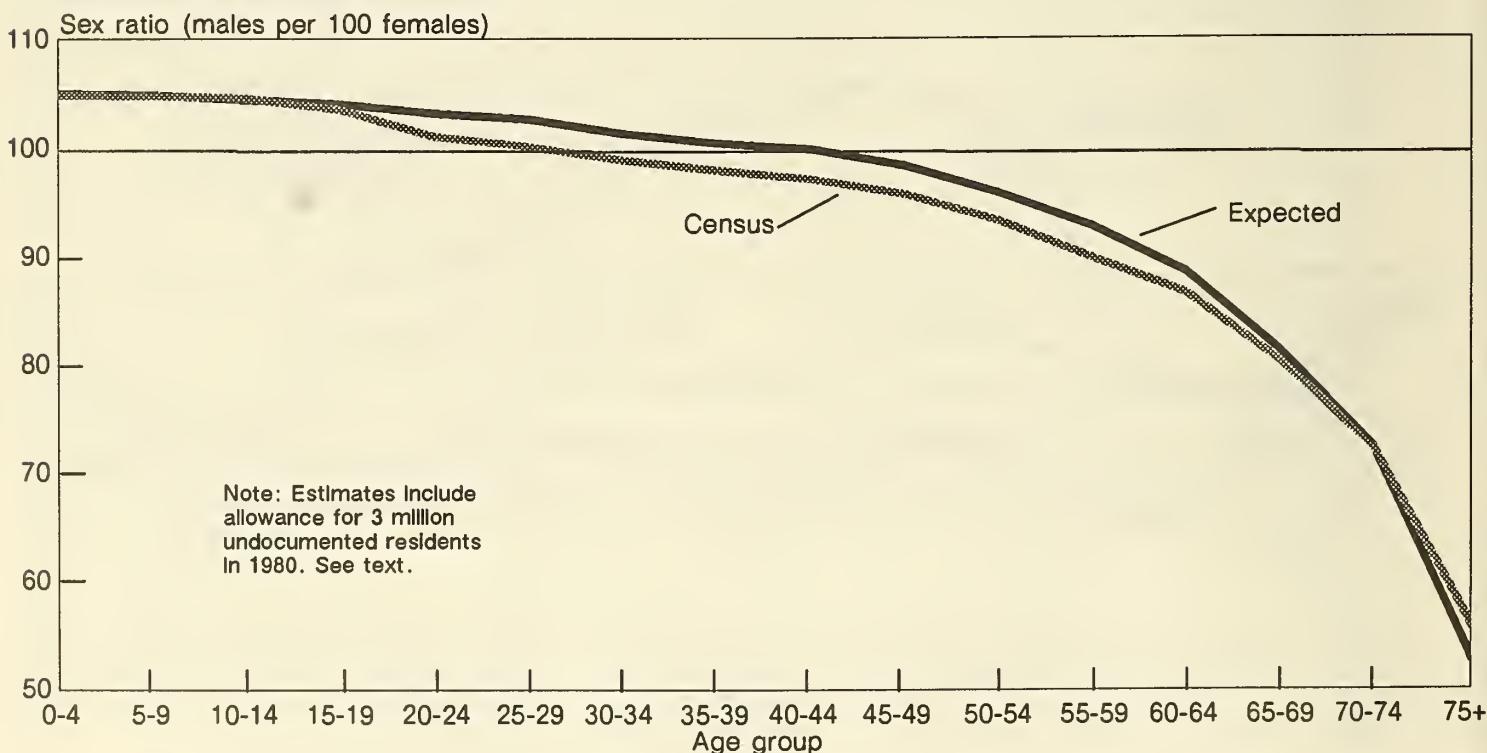


Figure 3.13.
**Census Sex Ratios and Expected Sex Ratios for Blacks,
by Age: 1970**

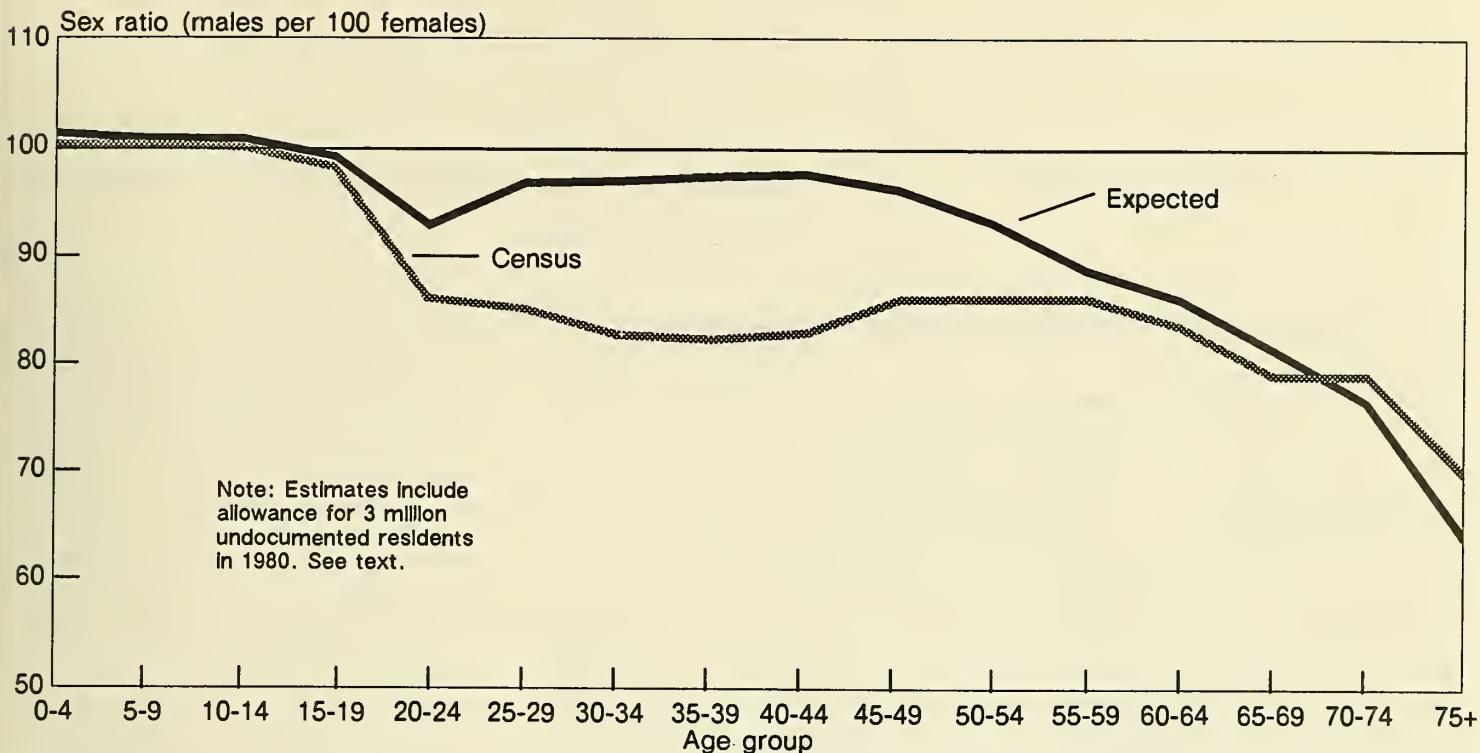
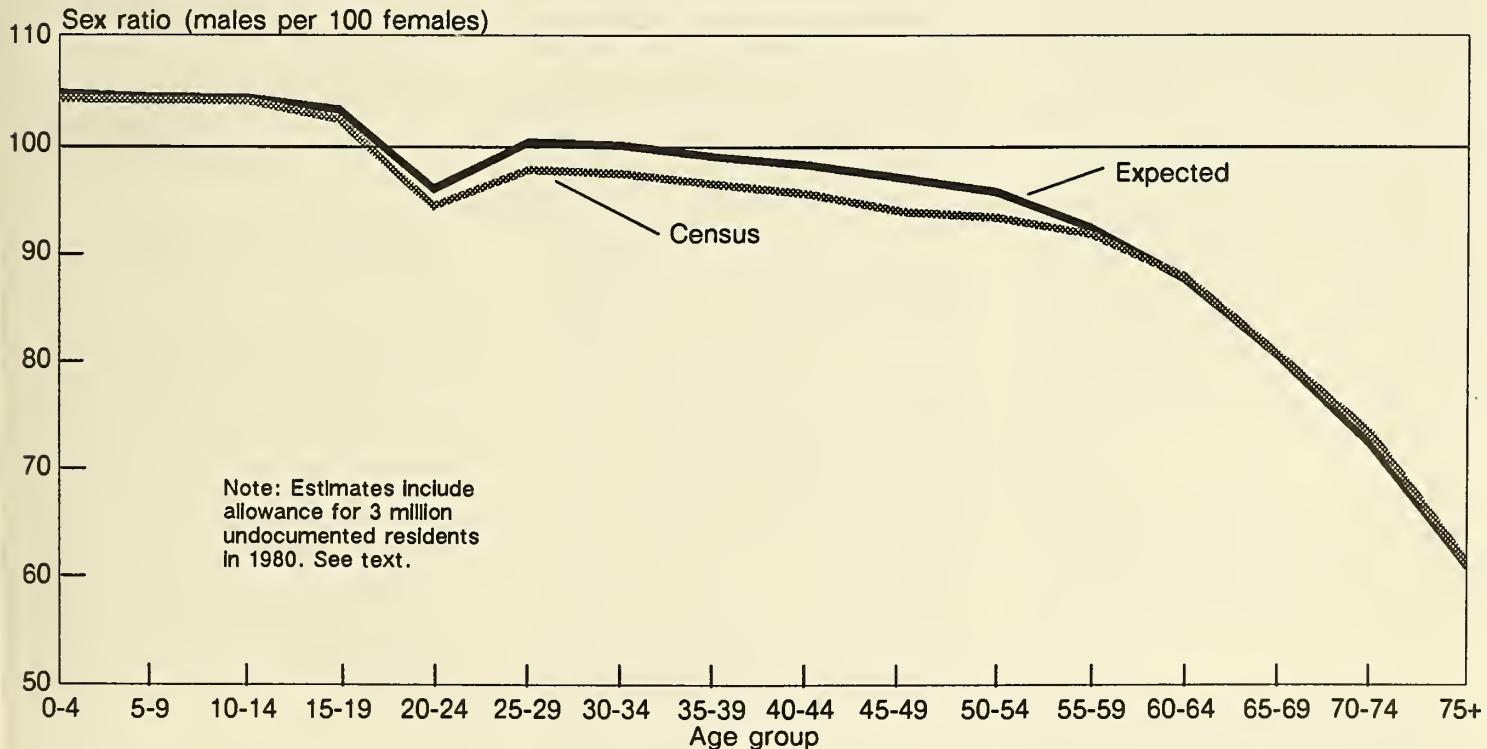


Figure 3.14.
Census Sex Ratios and Expected Sex Ratios for White-and-Other Races, by Age: 1970



Chapter 4.—Some Implications of the Findings

Census data are used to measure a variety of demographic phenomena and in a wide range of public programs. In this chapter, we investigate the effect of net census errors by age, sex, and race on various analytic demographic measures relating to the characteristics of the population. To do so, we compare the values of the measures when they are based on the census figures with their corresponding values based on the demographic estimates of the population. The census figures used in all calculations are the so-called "modified race" data (section 2.B.2). To simplify the comparisons, the demographic estimates used will be those based on the assumption that there were 3 million undocumented immigrants in the country in 1980.¹ If this assumption would have a major effect on the comparisons, the fact will be noted in the text.

4.A. IMPLICATIONS FOR BASIC DEMOGRAPHIC CHARACTERISTICS

4.A.1. Effect on Growth Rate

The resident population of the United States increased by 11.4 percent based on the official census counts for 1970 and 1980. When the comparison is based on the demographic estimates (with an allowance of 3 million undocumented immigrants), the "true" growth rate is only 9.7 percent for the decade. The growth rate derived with census data is nearly 19 percent higher than the rate as measured with the demographic estimates. The excess in the growth rate as measured by census data can be observed for all race groups in figure A, above.

¹Undocumented immigrants for 1960 and 1970 are estimated from the distribution by period of entry of undocumented immigrants in the 1980 census. See chapter 3.

Figure A. Percent Increase in the Population Between 1970 and 1980 and Between 1960 and 1970, by Race

Race	Cen-	Percent increase in population								
		1970-1980				1960-1970				
		sus	Demographic estimate (Number of undocumented immigrants in millions)				Cen-	Demographic estimate (Undocumented immigrants in 1980 in millions)		
All classes	11.4	9.4	9.7	10.0	10.4	13.4	12.8	12.9	13.0	13.2
White.....	9.3	7.5	7.8	8.1	8.5	12.2	11.6	11.7	11.8	11.9
Black	18.1	15.2	15.5	15.7	16.0	19.7	19.2	19.3	19.5	19.6
Other	101.3	86.9	87.3	87.8	88.3	58.0	53.3	54.9	56.6	58.3

The excess in the growth rate as measured by the census data can be attributed directly to the improved level of coverage in the 1980 census. Any improvements in coverage of the 1980 census over the 1970 census appear erroneously in the calculation as population growth. The difference between the growth rate as measured by demographic analysis (with an allowance for 3 million undocumented immigrants) and by the censuses is greater for Blacks than for Whites; the difference is 1.5 percentage points for Whites, but 2.7 percentage points for Blacks. The difference between the two represents the greater degree of improvement in coverage of Blacks between the two censuses.

The much greater difference in measured growth for the other-races population (14.0 percentage points) includes not only the effect of improvements in coverage, but also the effect of changes in response patterns. One significant change in particular, i.e., the much greater tendency of persons to respond as "American Indians" in the 1980 census,² accounts for most of the spurious growth in the other-races population as measured by the 1980 and 1970 censuses.

²Jeffrey S. Passel and Patricia A. Berman, "Quality of 1980 Census Data for American Indians," *Social Biology*, Vol. 33, No. 3-4, Fall-Winter 1986, pp.163-182.

The assumptions regarding the number of undocumented immigrants *do* have a significant effect on the growth rate as measured by demographic analysis. The growth rate is a function directly of the size of the population; it is not a proportion nor a measure of distribution. Thus, it is not surprising that additional persons contribute directly to the measured growth rate. Every additional 1 million undocumented immigrants in 1980 adds 0.3 - 0.4 percentage points to the estimated growth rate for the total population and for Whites.³ For Blacks, the effect is smaller; every 1 million undocumented immigrants (of all races) in 1980 adds 0.2 - 0.3 percentage points to the estimated growth rate. For other races, the corresponding figure of 0.5 - 0.7 percent is larger because of the relatively small other-races population in 1970.

For the 1960-1970 intercensal period, the observed (census) growth rates are in much closer agreement with the rates derived by demographic analysis. The error of closure is much smaller for the 1960 and

³The measured effect of undocumented immigration on 1970-1980 growth rates is not as large as the full number of undocumented immigration because only about three-quarters of each additional 1 million are assumed to have entered during the 1970s. The rest are assumed to have been in the country in 1970.

1970 censuses and the improvement in coverage is less than for the 1970 and 1980 censuses. In fact, the improvement in coverage of the 1970 census over the 1960 census is only marginal. Thus, the growth rates for the total population, Whites, and Blacks are affected by only about 0.5 percentage points by the use of the demographic estimates rather than the two censuses. Similarly, the number of undocumented immigrants assumed to have been in the country in 1960 and 1970 is much smaller than in 1980. Thus, the range of assumptions for undocumented immigrants in 1980 has little effect on measured growth for 1960-70 based on the demographic estimates.

4.A.2. Effect on Age Composition

In view of the fact that census undercount rates vary substantially by age, it is reasonable to expect that various measures of age distribution would be affected by census errors. Measures of the change in size of age groups over time based on census data can be distorted because the change is principally a function of differences in size between birth cohorts with an undercount effect superimposed. With the passage of time, census errors pass from one age group to another because census undercount appears to be a function of age rather than year of birth. (Note the similarity in age profiles shown in figures 3.5-3.8.) When the demographic estimates are used to measure change, the "cohort effect" of undercount is eliminated.

The magnitude of the cohort effect can be assessed with data from table 4.1 which shows a comparison of the percentage changes by age between 1970 and 1980 based on the census counts and based on the demographic estimate which includes 3 million undocumented immigrants. For the Black population, there are substantial differences between the census and the estimate in some age groups. Some age groups appear to have grown or declined much less rapidly than indicated by the demographic estimates, and some appear to have grown more rapidly. For example, the percentage change between 1970 and 1980 for ages 25 to 34 is reduced substantially when the demographic estimate is used instead of the census. The increase

is reduced from 61 percent to 49 percent for males and from 56 to 49 percent for females. Notable reductions also occurred for Black females aged 55 to 74 years. On the other hand, the percentage change for Black males aged 45 to 54 is increased substantially from 5 percent to 9 percent by use of the estimated population.

Notwithstanding the substantial effect of 1970 and 1980 census undercount on measures of change by age in the Black population (caused by the variability from age to age in Black undercount), the essential pattern of changes by age for the Black population is reflected by the census figures. Because net undercount rates are smaller and less variable from age to age in the White population, any effect on measures of change by age of using the demographic estimates is much smaller. Similarly, because of the small variability by age in undercount rates for females, the census figures for females reflect the actual change in population over time even more accurately than for males.

Use of the demographic estimates for 1970 and 1980 rather than the census has very little effect on another measure of age distribution—the median age—as shown in figure B, below.

There is no difference between the demographic estimate and the census in the

White population for either census; and for Blacks, the difference in the median age is only slight (0.3 years). The essential indications of all comparisons are unchanged by use of demographic estimates. Both the Black and the White populations grew older between 1970 and 1980 (as measured by median age) and the Black population was considerably younger at both dates.

Substitution of the demographic estimates for the census figures has only a negligible effect on the "dependency ratio" of the White population in either 1970 or 1980, as shown in figure C, below. (The dependency ratio is defined as the ratio of children under 18 and persons aged 65 years and over per 100 persons aged 18 to 64 years.) The census undercount has a moderate effect on the dependency ratio of the Black population; the ratio is lower in the demographic estimate than in the census in 1980 (73.5 vs. 76.4) and in 1970 (91.1 vs. 96.0). The ratios are lower in the demographic estimate because the population aged 18 to 64 years has a higher undercount rate than those younger and older. Even when the estimates are used, though, the general patterns remain the same. In both years, the Black dependency ratio is substantially higher than the White ratio. For both races, the dependency ratio fell substantially between 1970

Figure B. Median Age of the Population, 1980 and 1970, by Race

Race	Median age			
	1980		1970	
	Census	Demographic estimate	Census	Demographic estimate
All classes	30.0	30.1	28.1	28.1
White	30.9	30.9	28.9	28.9
Black	24.9	25.2	22.4	22.7
White-Black difference	6.0	5.7	6.5	6.2

Figure C. Dependency Ratio of the Population, 1980 and 1970, by Race

Race	Dependency ratio*			
	1980		1970	
	Census	Demographic estimate	Census	Demographic estimate
All classes	65.1	64.5	79.0	78.4
White	63.7	63.2	77.0	76.9
Black	76.4	73.5	96.0	91.1
White-Black difference	12.7	10.3	19.0	14.2

* Ratio of ages 0 to 17 years and 65 years and over per 100 persons aged 18 to 64 years.

and 1980 to the point where the Black ratio in 1980 is approximately the same as for Whites in 1970.

4.A.3. Effect on Sex Composition

The principal measure of sex composition is the sex ratio, the number of males per 100 females. As noted earlier, the relatively greater undercount of males than of females, regardless of race, has been a characteristic feature of enumeration in every recent U.S. census. This feature leads to distortions in sex ratios calculated directly with census data, as shown in table 4.2. Overall, the sex ratio of the resident population as measured by the census is 94.5, a figure which is lower by 1.8 points than the sex ratio of 96.3 computed from the estimated population. The overall difference is much smaller for Whites than for Blacks. The estimates show that there are almost 6 more Black males per 100 females than the census figures show, whereas the difference for Whites is only a little more than 1 male per 100 females.

For both Whites and Blacks, the "expected" sex ratios (i.e., the sex ratios based on the estimated population) exceed the "reported" or census sex ratios at most ages. (See table 4.2 and figures 3.11 through 3.14.) The deficits in the reported sex ratios are especially large for Blacks at ages 20 to 64 in 1980 and 20 to 54 in 1970. At these ages, the differences all exceed 5 males per 100 females and, on the average, between 10 and 11 Black males were missed for every 100 Black females counted at these ages. For example, the census counts show 83 Black males per 100 Black females at ages 35 to 44 years in 1980, but the estimates imply 96 males per 100 females, or a difference of 13 males per 100 females. Deficits of males amounted to 13 males per 100 females at ages 45 to 54 years in 1980 and to 10 per 100 females at ages 25 to 34. In 1970, extremely large deficits of Black males occurred at ages 25 to 34 (13 males per 100 females) and at 35 to 44 (15 per 100 females).

An exception to this pattern of too few males in the census occurs at the oldest ages (75 years and older). At these ages, the estimated proportion of males appears to be smaller than implied by the census counts because the undercount rates are

higher for females, the opposite of patterns encountered at most younger ages. For example, the expected sex ratio for Blacks at ages 75 and over in 1980 is 57 males per 100 females, rather than the 60 shown by the census.

As a result of the much larger relative undercounts in the Black data than the White data, White-Black differences in sex ratios are in fact much smaller at most ages in 1980 (and in 1970) than the census data show. Overall, the sex ratio difference is actually only 1.3 males per 100 females, rather than the 5.5 shown by the census figures. This conclusion is not affected substantially by assumptions about undocumented immigrants.

4.A.4. Effect on Racial Composition

The proportion of the population of each race is a frequently used measure of the racial composition of the population. The proportion Black, for example, is often used in legal cases to compare the composition of one group to another. As shown in figure D, below, the racial composition is little affected by census undercount. To the nearest whole percent, the percentage Black in the demographic estimate for 1980 is the same as in the census population—12 percent. For Whites and for other races, the proportions are also essentially the same in either population. Assumptions about undocumented immigrants in the population, within the range used (2 to 5 million), affect the percentages shown by at most 0.1 point.

In 1970, the proportionate distribution of the population by race is affected only slightly by census undercount. The proportion Black in the estimated population (11.7 percent) is only slightly larger than the

proportion Black in the census (11.1 percent). The magnitude of the difference in the proportions is the same for Whites as for Blacks.

4.A.5. Effect on Vital Rates

In calculating vital rates, population figures are generally used as denominators. If the estimated population figures are used rather than the census figures, crude rates (and age-specific rates) are reduced by the same percentage as the undercoverage rate of the population in the denominator. For example, the reductions in crude birth rate (1.3 per 1,000), crude death rate (0.5 per 1,000), and crude rate of natural increase (0.8 per 1,000) for the Black population in 1980 when the demographic estimate is used as the population base amount to about 6 percent; for 1970, the corresponding reductions are about 8 percent. (See table 4.3.) For Whites, the crude rates are changed negligibly (0.1 - 0.2 per thousand or less than a half percent) for 1980 when the denominators are based on the demographic estimates. For 1970, the reductions are larger (0.2 - 0.5 per thousand or about 2 percent), but still substantially smaller than the effect on the Black population.

For refined or adjusted rates, the denominators are restricted to specific age ranges or a standard age distribution is used. Thus, the effects are somewhat different than on crude rates, but they are generally quite small. The age-adjusted death rate for Blacks in 1980 is reduced by only 0.4 per 1,000, or 4.2 percent, when the demographic estimates of population are used to calculate the underlying age-specific rates. The general fertility rate and the total fertility rate are reduced by only 2.6 and 2.3 percent, respectively. For Whites,

Figure D. Proportion of the Population by Race, 1980 and 1970

Race	Percent of total population			
	1980		1970	
	Census	Demographic estimate	Census	Demographic estimate
All classes	100.0	100.0	100.0	100.0
White	85.9	85.5	87.6	87.0
Black	11.8	12.4	11.1	11.7
Other races	2.3	2.1	1.3	1.2
White-Black difference	74.1	73.1	76.5	75.3

Note: Census race distributions for 1980 based on "modified" race. (See section 2.B.2.)

the fertility measures are virtually unaffected because the undercount of White females over the age range 15 to 49 years in 1980 is essentially zero.

The effect of census undercount on estimated life expectancy is also not very large. (See table 4.4.) Again, the effects for Whites are much smaller than the effects for Blacks, because the adjustments to the denominators of the death rates used to compute the life expectancies are smaller for Whites. By far the largest effect is for Black-and-other-races males, where the life expectation at birth for 1980 is increased from 65.3 years to 66.0 years—an increase of only about 1 percent. Life expectancy at age 65 is affected by only a very small amount (measured in tenths of a year) for all race groups for all years shown in the table 4.4. The effect of undercount on life expectancy is so small because life expectancy is an average of death *rates* across all ages. Furthermore, death rates are generally very low in the age groups (20-54) where undercount rates tend to be the highest.

Census undercount does have a somewhat larger relative effect on differences between groups in life expectancy. For example, the difference in life expectation at birth in 1980 between White males and Black-and-other-races males is reduced from 5.4 years to 4.9 years (or about 10 percent) when the demographic estimates are used in place of census data in the underlying death rates. However, it should be

stressed again that the general relationship of male-to-female and White-to-Black life expectations, as well as the relative magnitudes of improvements over time, are virtually unaffected by census undercount.

4.B. CONCLUSION AND OTHER IMPLICATIONS

This review of the potential effects of census undercount shows that the general impression of the basic demographic situation of the United States is not seriously distorted by census undercount. For the White population, in fact, the census undercount in 1980 has virtually no discernible effect on many demographic measures at the national level (regardless of the assumptions about undocumented immigrants in the country). In general, the effect of census undercount depends on the item being measured. Measures that are counts of people or frequencies are obviously affected on a one-to-one basis by persons omitted from the census. Rates, proportions, and more complex demographic measures are relatively less affected because of averaging or cancellation of undercount effects.

The general conclusion about the relatively small magnitude of any effect of census undercount applies to the demographic characteristics reported here. There are of course other important areas covered by census materials which have not been discussed. Demographic analysis tells us

nothing at all, for example, about differences in census coverage for social and economic characteristics.

For many applications, any possible effect of census undercount is not in the number of people omitted at the national level, but in differences among geographic areas within the United States. Some examples would include legislative apportionment and programs such as General Revenue Sharing in which funds are allocated in part on the basis of population. Analysis of the effect of census errors on such applications requires an assessment of the undercount for sub-national areas. Some such studies have been done,⁴ but they are beyond the scope of this section because the estimates described here are only for the national undercount, not for subnational areas.

⁴Some examples include J. Gregory Robinson and Jacob S. Siegel, "Illustrative Assessment of the Impact of Census Underenumeration and Income Underreporting on Revenue Sharing Allocations at the Local Level," *Proceedings of the Social Statistics Section*, 1979, American Statistical Association, Washington, DC; Leon Gilford, Beverly D. Causey, and Naomi D. Rothwell, "How Adjusting Census Counts Could Affect Congress," *American Demographics*, 4, 1982, pp. 30-33; Jeffrey S. Passel and J. Gregory Robinson, "The Effect of Data Errors and Census Undercount on General Revenue Sharing Allocations," paper presented at the annual conference of the American Planning Association, Minneapolis, Minnesota, May 1984.

Table 4.1. Percent Change in the Population Between 1970 and 1980, for Broad Age Groups, by Sex and Race

Sex and age	White			Black		
	Census	Demographic estimate	Difference	Census	Demographic estimate	Difference
Males, all ages.....	9.2	7.9	1.3	17.3	15.0	2.3
Under 5 years.....	-7.0	-9.1	2.1	1.6	0.7	0.8
5 to 14 years.....	-16.7	-18.0	1.3	-6.1	-7.7	1.7
15 to 24 years.....	18.4	17.7	0.7	37.6	32.3	5.3
25 to 34 years.....	47.3	45.7	1.6	60.9	48.6	12.3
35 to 44 years.....	10.0	8.8	1.1	14.1	12.3	1.8
45 to 54 years.....	-3.4	-4.7	1.3	4.7	8.8	-4.1
55 to 64 years.....	14.7	14.0	0.7	15.5	14.7	0.8
65 to 74 years.....	23.7	21.5	2.2	23.0	20.6	2.4
75 years and over.....	19.7	17.0	2.7	35.6	38.1	-2.5
Females, all ages.....	9.4	7.7	1.7	18.9	15.5	0.5
Under 5 years.....	-7.6	-9.4	1.8	0.5	0.0	3.0
5 to 14 years.....	-17.2	-18.3	1.1	-7.0	-8.3	1.3
15 to 24 years.....	14.1	13.1	0.9	33.9	29.3	4.6
25 to 34 years.....	43.9	42.4	1.5	56.0	49.0	7.0
35 to 44 years.....	8.2	7.1	1.1	13.7	14.5	-0.8
45 to 54 years.....	-4.6	-5.7	1.1	11.0	9.0	2.0
55 to 64 years.....	16.4	12.8	3.6	22.0	14.9	7.1
65 to 74 years.....	24.7	20.8	3.9	33.4	28.4	5.0
75 years and over.....	37.6	34.0	3.6	59.0	57.6	1.5

Note: Demographic estimate includes an allowance for 3 million undocumented residents in 1980 and a corresponding (smaller) allowance in 1970.
See text.

Table 4.2. Sex Ratios of the White and Black Populations, by Age: 1980 and 1970

(Sex ratio is males per 100 females)

Race and age	1980			1970		
	Census	Demographic estimate	Difference	Census	Demographic estimate	Difference
White						
All ages.....	95.1	96.5	-1.4	95.3	96.4	-1.1
Under 5 years.....	105.1	105.4	-	104.6	105.1	-0.5
5-9 years.....	105.2	105.3	-0.1	104.5	104.7	-0.2
10-14 years.....	105.0	104.9	0.1	104.5	104.5	-0.2
15-19 years.....	103.9	104.3	-0.4	102.7	103.5	-0.8
20-24 years.....	101.5	103.6	-2.1	94.7	96.3	-1.6
25-34 years.....	100.3	102.8	-2.5	98.0	100.6	-2.6
35-44 years.....	98.0	100.7	-2.7	96.4	99.2	-2.8
45-54 years.....	95.0	97.4	-2.4	93.8	96.6	-2.8
55-64 years.....	88.6	91.1	-2.5	85.4	90.2	-4.8
65-74 years.....	76.7	77.3	-0.6	77.3	76.8	0.5
75 years and over.....	54.6	53.7	0.9	62.8	61.5	1.3
Black						
All ages.....	89.6	95.2	-5.6	90.8	96.0	-5.2
Under 5 years.....	101.6	102.3	-0.7	100.5	101.6	-1.1
5-9 years.....	101.6	102.2	-0.6	100.5	101.1	-1.1
10-14 years.....	101.2	101.3	-0.1	100.3	101.1	-0.8
15-19 years.....	99.6	100.0	-0.4	98.4	99.4	-1.0
20-24 years.....	91.4	97.5	-6.1	86.3	93.1	-6.8
25-34 years.....	86.9	96.8	-9.9	84.2	97.1	-12.9
35-44 years.....	83.1	95.8	-12.7	82.8	97.8	-15.0
45-54 years.....	81.5	94.9	-13.4	86.3	95.0	-8.7
55-64 years.....	80.6	87.6	-7.0	85.1	87.7	-2.6
65-74 years.....	73.1	74.8	-1.7	79.2	79.5	-0.3
75 years and over.....	60.3	56.8	3.5	70.7	64.8	5.9

Note: Demographic estimate includes an allowance for 3 million undocumented residents in 1980 and a corresponding (smaller) allowance in 1970.
See text.

Table 4.3. Vital Rates by Race: 1980 and 1970

(Rates per 1000 population. Base of percent difference or change is rate for White population or rate in 1970)

Race and measure	1980			1970			Percent change 1970-1980	
	Census	Demo-graphic estimate	Difference	Census	Demo-graphic estimate	Difference	Census	Demo-graphic estimate
Crude birth rate								
Total	15.9	15.7	-0.2	18.4	17.8	-0.5	-13.1	-11.8
White.....	14.9	14.8	-0.1	17.4	17.0	-0.4	-14.2	-13.0
Black	22.1	20.8	-1.3	25.3	23.3	-2.0	-12.8	-10.8
Percent White-Black difference	48.4	41.0	(X)	46.1	37.4	(X)	(X)	(X)
Crude death rate								
Total	8.8	8.7	-0.1	9.4	9.2	-0.3	-7.1	-5.6
White.....	8.9	8.8	-0.1	9.4	9.2	-0.2	-5.4	-4.1
Black	8.7	8.2	-0.5	10.0	9.2	-0.8	-12.5	-10.6
Percent White-Black difference	-2.1	-7.1	(X)	5.8	-0.4	(X)	(X)	(X)
Crude rate of natural increase								
Total	7.2	7.1	-0.1	8.9	8.7	-0.2	-19.6	-18.4
White.....	6.0	5.9	-0.1	7.9	7.7	-0.2	-24.7	-23.7
Black	13.4	12.6	-0.8	15.4	14.1	-1.2	-13.0	-10.9
Percent White-Black difference	124.2	113.2	(X)	94.1	82.7	(X)	(X)	(X)
General fertility rate								
Total	68.4	68.2	-0.2	87.9	86.5	-1.4	-22.2	-21.2
White.....	64.8	64.7	-0.1	83.8	82.9	-0.9	-22.7	-22.0
Black	87.9	85.6	-2.4	115.3	109.1	-6.2	-23.7	-21.6
Percent White-Black difference	35.8	32.3	(X)	37.5	31.6	(X)	(X)	(X)
Total fertility rate								
Total	1839	1833	-6	2478	2436	-42	-25.8	-24.8
White.....	1749	1746	-4	2378	2352	-26	-26.4	-25.8
Black	2259	2206	-53	3099	2921	-178	-27.1	-24.5
Percent White-Black difference	29.1	26.4	(X)	30.3	24.2	(X)	(X)	(X)
Age-adjusted death rate ¹								
Total	8.8	8.7	-0.1	10.4	10.0	-0.3	-15.3	-13.6
White.....	8.5	8.4	-0.1	10.0	9.7	-0.3	-15.1	-13.2
Black	11.5	11.0	-0.4	13.7	12.9	-0.8	-16.1	-14.4
Percent White-Black difference	34.5	31.1	(X)	36.2	33.0	(X)	(X)	(X)

(X) Not applicable.

¹Total population in 1980 is used as standard population.

Note: Demographic estimate includes an allowance for 3 million undocumented residents in 1980 and a corresponding (smaller) allowance in 1970. See text.

Table 4.4. Expectation of Life at Birth and at Age 65 in Various Abridged Life Tables, by Sex and Race

Race, sex, and year	Expectation of life at birth		Expectation of life at age 65	
	Census	Demographic estimate	Census	Demographic estimate
White male				
1980	70.7	70.9	14.2	14.2
1970	68.0	68.3	13.2	13.3
1959-61	67.6	67.9	13.0	13.1
Increase, 1959-61 to 1980	3.1	3.0	1.2	1.1
White female				
1980	78.1	78.3	18.5	18.7
1970	75.6	76.0	17.1	17.4
1959-61	74.2	74.7	15.9	16.3
Increase, 1959-61 to 1980	3.9	3.6	2.6	2.4
Black-and-other-races male				
1980	65.3	66.0	13.5	13.4
1970	61.3	62.8	13.3	13.2
1959-61	61.5	62.4	12.9	12.3
Increase, 1959-61 to 1980	3.8	3.6	0.7	1.1
Black-and-other-races female				
1980	73.7	73.9	17.3	17.5
1970	69.4	70.2	16.4	16.8
1959-61	66.5	67.1	15.2	14.8
Increase, 1959-61 to 1980	7.2	6.7	2.2	2.7

Note: Demographic estimates includes an allowance for 3 million undocumented residents in 1980 and a corresponding (smaller) allowance in 1970.
 See text.

Chapter 5.—Evaluation of Census Coverage Through Direct Measurement: the PEP

5.A. GENERAL DESCRIPTION

The 1980 Post-Enumeration Program (PEP) attempted to measure census coverage through direct measurement using sample survey methods. Samples of persons were selected for the PEP to check whether they were counted in the census, and samples of enumerated persons were selected from the census to determine whether they were counted correctly. This case-by-case approach contrasts with that of demographic analysis, which relies on aggregate statistics.

The strategy of evaluating the census at the level of individual enumerations required the survey design of PEP to take into consideration many features of the design of the census itself. The next section of this chapter describes features of the 1980 census with important implications for the conduct and interpretation of PEP.

Section 5.C presents a summary of the basic PEP procedures, although a more thorough documentation is presented in PERM 130. Section 5.D describes the basic dual-system estimator employed by PEP and lists the assumptions on which this estimator is based.

Chapter 6 discusses many of the limitations of the PEP data and assumptions. The purpose of this chapter is to present a broad overview of the methodological issues; most of these issues are examined in greater detail in individual PERM reports. Alternative dual-system estimates were prepared to represent the possible effect of some of these methodological limitations. Chapter 7 presents different sets of estimates of undercount from the PEP; chapter 8 compares estimates from PEP and demographic analysis.

5.B. SUMMARY OF 1980 CENSUS PROCEDURES

This section summarizes basic aspects of the implementation of the 1980 census that represent important background for

the discussion in this report. For further information, two Census Bureau publications, *The 1980 Census of Population and Housing: Users' Guide, Text and Glossary, PHC80-R1*, and *the History, PHC80-R2*, provide more complete descriptions of census concepts and procedures.

Approximately 95 percent of the country was enumerated through the mailout/mailback census procedure in which census forms were mailed to housing units on or about March 28, 1980, with the request to complete the questionnaire as of Census Day, April 1, 1980, and return it by mail. The remaining 5 percent was enumerated conventionally. In the conventional census as implemented in 1980, respondents received questionnaires from postal carriers, but the enumeration was completed by census enumerators who collected the questionnaires. In both conventional and mailout/mailback areas, persons not living in households, for example, those in the Armed Forces or in institutions, were enumerated by still other means.

Data collection was managed by 409 district offices (DO's): 373 administered the mailout/mailback census, 24 were conventional offices, and 12 had both conventional and mail procedures. The basic work unit of collection was the census enumeration district (ED). There were approximately 331,000 ED's in the United States, averaging about 270 housing units each.

The address register in each ED was used to record the status of enumeration for each housing unit in the ED. A census serial number linked a census questionnaire for a unit within the ED to an entry in the address register. This serial number was clerically entered in machine-readable form on each questionnaire.

One fundamental difference between the mailout/mailback and conventional DO's was the manner in which the address list in the address register was assembled. In mailout/mailback areas, the pre-census address list was in computer-readable form, which enabled the printing of mailing labels for

the mailout and of address registers based on this list. In conventional areas, census enumerators completed the address registers during the enumeration. There were two methods for creating the address list in mail areas: purchase of a computerized commercial mailing list for the area, or initial canvass by census enumerators, from which listed addresses were entered into computer files by keying. These two methods were referred to as the tape address register (TAR) and prelist procedures, respectively.

The TAR areas, where commercial lists were employed, were primarily in the urbanized parts of the country. Conversely, prelisting was required in less urbanized areas with higher concentrations of rural addresses, sometimes without a street numbering system.

The initial lists created under both methods were supplemented through checks performed by local post offices. In TAR areas, an early check by the local post offices was followed by the precanvass, a field review by census enumerators. In both types of mail areas, postal checks were done about a month before, and again during, the delivery of forms.

As households mailed back their questionnaires to their respective district offices, the receipt of each questionnaire was recorded on the corresponding line in the address register according to serial number. Approximately 85 percent of households in mail areas responded by mail.

Followup 1 of questionnaires that had not been received by mail began in mid-April to collect data from nonresponding housing units and to record units that were vacant. Followup 2 started in mid-June to obtain corrected information from households whose questionnaires had failed edit because of missing or incomplete questionnaire items when this information could not be collected by phone, and to verify that units classified as vacant or nonexistent in Followup 1 were correctly classified.

Additionally, remaining nonresponse cases from Followup 1 were transferred to Followup 2.

Followup 2 included a number of other coverage improvement operations. For example, in about 250 DO's, lists of names and addresses from administrative sources, such as state driver's license files and files of registered aliens from the Immigration and Naturalization Service, were checked in urban areas with high concentrations of minorities.

In a general mailing in conventional areas, local post offices delivered census questionnaires with the basic items asked of all persons and housing units. Census enumerators picked up completed questionnaires or interviewed households while manually completing a census address register for the ED. The coverage of addresses was checked later by the local post offices. The conventional census also included some aspects of Followups 1 and 2 performed in mail areas.

A special-place operation in each DO collected the data for persons not in households, either by direct interview or by gathering previously distributed and completed questionnaires. These persons represented approximately 2.5 percent of the population nationally, with about 1.1 percent classified as inmates of institutions and 1.4 percent for all remaining categories of group quarters. For this population and in other situations in which household questionnaires could not be feasibly used, individual questionnaires were employed and the results were either later transcribed to household questionnaires or included directly in the computer processing.

At the end of Followup 2, a relatively small proportion of cases remained noninterviews. These cases were handled by "close-out" procedures that required enumerators to obtain a report of the occupancy status and, when applicable, the number of occupants, from neighbors. Four different outcomes were possible: 1) the unit was determined to be vacant; 2) the unit was determined to be occupied and the number of occupants was obtained; 3) the unit was determined to be occupied but by an unknown number of persons; or 4) the occupancy status could not be determined. The census processing compensated for incomplete enumeration for the last three of the four outcomes. When the number of occupants was known, the characteristics were substituted from a

nearby household of the same size. Approximately 1.2 percent of the population total represents persons counted in this manner. When the housing unit was occupied by an unknown number of occupants, the number and characteristics of the household were substituted from a nearby household. Finally, when the occupancy status was unknown, the occupancy status was substituted from a nearby housing unit, and, if the resulting substituted status was "occupied," the number and characteristics of the occupants were substituted as before. These last two groups contributed approximately 0.3 percent of the total population count. Overall, approximately 1.4 percent of the population were substituted for reasons of noninterview. (The apparent discrepancy between 1.4 percent and 1.2 + 0.3 percent arises from rounding.)

A limited number of questions on basic population characteristics were asked of all enumerated persons. On the short-form questionnaire used for approximately 81 percent of all housing units, seven items were asked for each person: name, household relationship, sex, race, age, marital status, and Spanish origin. The short form also included nine questions about the housing unit and three questions to ensure that no person had been omitted. A random sample of housing units and persons in special places were selected for the long-form questionnaire, which added questions on 26 population and 20 housing unit subjects to the basic items on the short form.

In mail areas, the sample of housing units for the long form was initially selected from the mailing lists, and the appropriate forms were sent to households in the original mailing according to this selection. In conventional areas, as enumerators canvassed their assigned ED's to collect completed short-form questionnaires, they conducted sample interviews at the designated sampling rate. The distinction between the short and long form is one of the most basic features of the census design; yet, it is of relatively less importance for PEP since essentially all of the analysis depended only upon the items common to both forms.

Upon completion of the enumeration, district offices shipped the census questionnaires, address registers, and other material to one of three processing centers. The questionnaires were photographed on microfilm and captured by an optical reading system, FOSDIC, that transferred the data

to computer tape at the three centers. The tapes eventually were assembled at Bureau headquarters into a computer file that became the basis of the final counts.

5.C. SUMMARY OF THE POST ENUMERATION PROGRAM PROCEDURES

5.C.1. Overall Design

Three separate surveys are the principal sources for the PEP:

- (a) the April 1980 sample of the Current Population Survey (CPS), comprising approximately 84,000 households;
- (b) the August 1980 sample of CPS, also comprising approximately 84,000 households; and
- (c) the E sample, a sample of approximately 110,000 households selected from the census itself.

The CPS is conducted monthly by the Census Bureau for the Bureau of Labor Statistics to estimate national employment and unemployment rates and other labor force characteristics. The April and August 1980 samples constitute different samples of households, and each may be regarded as a separate survey of the civilian, noninstitutional population. These two samples, which were also referred to as the "P" or "Population" samples for purposes of PEP, were supplemented for PEP by a sample of military persons. In most analyses discussed in this report, the military sample is included as part of the P sample in order to represent the total noninstitutional population. A separate P sample of institutional persons was also selected, but the results for this group are presented separately in PERM 122 and are excluded from the estimates considered in this report.

The purpose of the P samples in the PEP was to measure the proportion of persons missed from the census or otherwise not correctly enumerated. More precisely, the P-sample estimate was intended to represent the proportion of persons who could not be matched to a complete census enumeration with sufficient information to determine the match. This estimate was derived by attempting to match the

samples to enumerations in the census. In cases where the sample persons had moved between Census Day, April 1, 1980, and the time of the CPS interview, an attempt to obtain the Census Day address was made and, if successful, a match to the census was tried there.

The third major sample, the "E" or "Enumeration" sample, was selected from census enumerations. One purpose of the E sample was to measure the instances in which the inclusion of an enumeration in the census was incorrect, that is, an erroneous enumeration. For example, if a family had moved away from an address to a new permanent home before Census Day, an enumeration of these people at the old address would be incorrect by census definitions. As a second example, census definitions required college students living in dormitories on Census Day to be enumerated as living there: cases in which the students were also included on their families' forms represent another source of erroneous enumeration. The E sample was also used to estimate the number of erroneous enumerations through duplication in the census, as may have happened when two forms were filled out for the same household and both included in the final count.

The E sample was also used to estimate the number of enumerations that had been mistakenly included in the wrong ED in the census, far enough away from the correct census ED so that they would have been beyond the area of search for matching purposes in the P sample. Estimates of these enumerations were required for purposes of dual-system estimation. This source of error was estimated by rechecking the location recorded in the census against the actual location for each household in the E sample.

5.C.2. P-Sample Operations

To facilitate matching to the census, detailed information about each household and each household member was obtained in the CPS and the additional P samples. Data from the CPS samples were collected through a supplemental questionnaire administered by CPS interviewers at the end of the CPS interview. In August, the supplement included questions to ascertain where each person

in the CPS household lived on Census Day, since an appreciable number of persons had moved between Census Day and the time of interview. In both April and August, the interviewer also drew a sketch map locating the CPS address relative to major roads in the area. The information on the sketch map was used to attempt to determine for each CPS household its location in terms of DO, ED, and block within ED.

The geographic information for each CPS household was used to attempt to locate the matching questionnaire in the census. Once this questionnaire was found, a check was made to ascertain that each person in the CPS household was on the census questionnaire. For individuals reported to have moved on the August supplement, their April 1 address was determined, and additional questions were asked to assist in locating their Census Day address with respect to census geographic organization. In these cases, the Census Day address was used in place of the CPS address to search for the census questionnaire.

Most of the P-sample cases, approximately 86 percent excluding noninterviews, were matched by this initial matching effort. After a clerical review checked for false matches, the cases matched at this point were considered complete and included among the estimated matches to the census in all subsequent analyses.

If a census questionnaire for a household could not be located, or if some persons were not listed on it, the CPS case was returned to the field for reconciliation. Approximately 13 percent of the P sample was included in this followup. The followup was regarded as an essential step in determining that any specific P-sample case was a true nonmatch to the census, since extraneous factors may have prevented an initial match to the census. The following list includes alternative circumstances leading to an initial nonmatch.

- (a) The sketch map may have been incomplete or incorrectly drawn and led to the wrong ED being searched for the census questionnaire.
- (b) The CPS or Census Day address may have been incorrectly transcribed or reported.

- (c) For the sake of simplicity, the April supplemental questionnaire had not asked about Census Day address, so that an initial nonmatch should have resulted whenever April P-sample persons had a Census Day address different from the CPS address approximately two to three weeks later.
- (d) Contrary to census definitions, CPS definitions included as part of the household students living in dormitories away from home. Parents frequently named such students as members of the household in both the April and August supplements, even though the address of the college dormitory was the appropriate address for purposes of matching to the census.
- (e) Responses to the April and August supplements for an entire household were collected from a single household respondent in almost all instances. Hence, in some cases the household respondent may have had additional difficulty in accurately and completely reporting Census Day address for other members of the household.
- (f) Some cases were not matched to the census originally simply because of insufficient matching effort, and a correct match could have been obtained even without the follow-up interview. This problem particularly occurred at the end of the initial matching attempt, when it became important in terms of timing to follow up any remaining unmatched cases.

Naturally, cases without any corresponding census enumerations also would have remained unmatched after the initial matching effort.

Some cases were not sent to followup even though they were unmatched in the initial matching attempt. Approximately 1 percent of the P-sample cases were not sent to followup and were never matched. These cases included instances in which sampling materials were lost or misplaced, but the largest portion of them represented a group of cases for which the census questionnaires were presumed lost. In retrospect, these cases should have been

sent for followup. The circumstances and treatment of these cases are described further in PERM 123.

The followup was conducted principally in the winter and spring of 1981. On the return from followup, each case was classified either as a complete followup interview, in which an interview had been made with an appropriate respondent, or as an incomplete followup interview.

Complete followup interviews were then further divided according to whether adequate geographic information had been obtained to enable an attempted match to the census. As a result of followup, a new address or ED was frequently obtained. In some cases, where the exact ED was impossible to determine, a group of up to four ED's would be treated as the area of search for the case if it appeared essentially certain that one of the selected ED's was the correct one. Thus, in effect, the P-sample procedures allowed an extended search through an area larger than a single ED in instances where precise geographic coding proved difficult.

A case remaining unmatched after a complete followup interview judged to have yielded a well-defined area of search was considered to be a nonmatch to the census. The followup also yielded a large number of matched cases as a result of information from the followup and increased matching effort.

A substantial amount of missing data remained after the followup. Section 6.C gives a description of the various types of incomplete data and the alternative treatments of these data in estimation.

After an initial effort to analyze the data in 1981, a number of "clean-up" operations were implemented in late 1981 and in 1982. Some of this work was simply to complete operations that had been delayed earlier. One operation was restricted to noninterview households in the April CPS, which until then had been excluded from any matching activities. These households, called type A noninterview households in CPS, lacked the usual PEP supplement form. Because of the design of the CPS, these housing units had been in the CPS sample in either March or May and often in both. For cases not interviewed in April but interviewed either in March or May, CPS information was transcribed onto supplemental forms and used for an attempted match to the census. April type A cases without usable March or May information

were excluded from this study. Because of the much higher number of persons moving between Census Day and the August CPS than in April, a similar operation was not undertaken for the August sample. Results from the April type A estimates were incorporated into some of the alternative PEP estimates.

5.C.3. E-Sample Operations

The E sample was used to estimate definitional errors, duplication and geocoding errors in the census. The sample of approximately 110,000 housing units was selected in clusters of about 10 housing units per ED.

A 50-percent subsample of the E sample, averaging about five households per ED, was selected for a within-ED search for duplicate enumerations. Names and other information for the selected households were transcribed to a separate form. Clerks then used this form as a reference for searching the entire ED for any additional enumerations of the same persons.

A reinterview was attempted for the full E sample. Questions in the reinterview asked where the persons lived on Census Day and if there were any other addresses where they might have been enumerated. Answers to these questions were used to determine if each person should have been enumerated, and, if so, where. The preferred respondent for the reinterview was any knowledgeable adult in the sampled census housing unit, who typically (but not always) would have been a member of the sampled enumerated household. If the preferred respondent was unavailable or could not answer the questions, other knowledgeable respondents, such as neighbors or rental agents, were asked about the enumerated household's actual residence on Census Day. Finally, the remaining proportion were referred to the post office to attempt to confirm the residence and composition of the household on Census Day.

While the interviewers conducted the E-sample interview, they also confirmed the ED code assigned in the census. If the interviewer agreed with the ED code of the ED from which the E-sample case had been sampled, the housing unit was considered to be correctly geocoded. In the cases of disagreement, a number of additional operations were instituted to

reconcile the discrepancy, with the frequent outcome that the original census coding was found to be correct.

For cases in which the correct ED could not be determined or was found to be different from the census ED, additional clerical and field checks were made. These steps attempted to determine if the ED from which the E-sample case had been sampled was within the effective P-sample area of search. In other words, the E-sample case would be considered to be within the P-sample area of search if the P-sample search operations would have led to the E-sample ED. For example, if an E-sample case in a rural area was found to have been enumerated in the ED across the street from the correct ED, it would not have been counted as a geocoding error if the sampled ED probably would have been examined during the extended search for the P sample. On the other hand, the intent was to classify as a geocoding error any E-sample case enumerated in an ED so far away from the correct ED that a match would never have been made if the household had been included in the P sample instead. In some cases, the available information was inadequate to complete these steps, and the cases were classified as incomplete.

By the same logic that requires duplicate enumerations within the same ED to be counted as erroneous enumerations to measure net census error, duplication enumerations between different ED's also must be counted as sources of erroneous enumerations. A distinction between two situations is important.

- (a) A duplicate enumeration may have occurred in an ED in which the enumeration would have been counted as a geocoding error. In a sense, two sources of error are involved—geocoding and duplication. From the point of view of estimation, however, it is necessary to count the duplicate enumeration only once as an erroneous enumeration, since the duplication inflated the census count by one. Since geocoding errors were already included as erroneous enumerations in the estimation, it was unnecessary to determine if duplication had also occurred.

- (b) On the other hand, when duplication occurred between two different ED's within the P-sample area of search, so that neither enumeration would be counted as a geocoding error according to the procedures used by the E sample, it is logically necessary to identify the effect of this sort of duplication on erroneous enumerations in the census.

Limited procedures were instituted to search for duplications between ED's when these ED's had been identified as the possible areas of search in the last stage of the geocoding operations for the E sample. This check produced a very small number of such duplications, which have been included in the dual-system estimates. A later study, the Housing Unit Coverage Study (HUCS), uncovered more between-ED duplications by checking for duplications between any ED's that had been identified as possible ED's in the E-sample geocoding operation. The effect of these missing data is discussed further in section C of chapter 6, and estimates of the additional duplications, approximately 300,000 persons in all or over 0.1 percent of the total census count, are presented in PERM 119.

5.D. DUAL-SYSTEM ESTIMATION

5.D.1. Motivation for Dual-System Estimation

Dual-system estimation was employed in PEP. This procedure attempts to compensate for the imperfect coverage of the P sample. Dual-system estimation makes a specific assumption about the nature of the imperfect coverage; this section describes this assumption and the implementation in PEP.

The incompleteness of CPS coverage has been noted for several years and can be confirmed by a simple analysis. When the reciprocal of the probability of selection of each CPS person is used as a weight, the weighted sample total estimates the hypothetical interviewed population if the CPS were a census instead of a sample survey, that is, if an interview were attempted at each household and

special place covered by the CPS frame instead of only at the sampled units. Furthermore, the next stage of weighting, the noninterview adjustment, approximately adjusts for persons in occupied households that were sampled but not interviewed. The weighted sample total based upon the noninterview adjustment is systematically below the population count according to the actual census. Thus, the CPS cannot be assumed to represent the entire U.S. population when the reciprocal probability of selection adjusted for noninterviews is used as a weight.

The deficiencies in the CPS coverage stem from at least two sources: persons in housing units that are not included in the CPS sampling frame; and other persons who are unreported at interviewed households or who by some other means effectively escape the conceptual framework for CPS household membership. The division of importance between these two sources of deficiency has proved difficult to quantify, although it appears that both are important.

Appendix F presents further details of P- and E-sample estimation.

5.D.2. The General Method

Dual-system or capture-recapture methodology was originally developed as a procedure for estimating the size of animal or fish populations. Over several hundred years, the estimator and procedure have been rediscovered several times and so have been given several names, including capture-tag-recapture, the Lincoln estimator, the Petersen estimator, the Schnabel estimator, and the dual-system estimator. The last is the most commonly used term for application to human populations. Chandrasekar and Deming¹ described the use of the procedure for evaluation of censuses and vital registration systems. Marks, Seltzer, and Krotki² extended this technique.

Cowan and Malec³ and Wolter⁴ have provided further reviews, developments, and references to some of the considerable literature in this field.

In the original form, the capture-recapture procedure requires two samples of the population to be measured. In the first sample, a random segment of the population is caught, counted, tagged in some easily identifiable manner, and released. This is followed by a second sample, in which an independent random segment of the population is caught, counted, and released. In the second count, a tally is also made of the number tagged from the first count. The data are then displayed in a two-way table, as in figure E.

Figure E. Distribution of Sample in Capture-Recapture Estimation

First sample	Second sample		
	Caught	Not caught	Total
Caught.....	M	-	F
Not caught	-	-	-
Total.....	S	-	N

In figure E, F and S are the numbers caught in the first and second samples, respectively, M is the number caught in both samples, and N is the unknown population total. On the assumption that the event of being caught in the first sample is independent of being caught in the second sample, then in expectation the ratio of the number, M, of those captured in both samples, to the number, S, caught in the second sample should be equal to the ratio of those caught in the first sample, F, to the total population, N; the relationship expressing this is:

$$M/S = F/N.$$

¹C. Chandrasekar, and W. Edwards Deming, "On a Method of Estimating Birth and Death Rates and the Extent of Registration," *Journal of the American Statistical Association*, Vol. 44 (March 1949), pp. 101-115.

²Eli S. Marks, William Seltzer, and Karol J. Krotki, *Population Growth Estimation*, The Population Council: New York, 1974.

³Charles D. Cowan, and Donald Malec, "Capture-Recapture Models When Both Sources Have Clustered Observations," *Journal of the American Statistical Association*, Vol. 81 (June 1986), pp. 347-353.

⁴Kirk M. Wolter, "Some Coverage Error Models for Census Data," *Journal of the American Statistical Association*, Vol. 81 (June 1986), pp. 338-346.

This relationship suggests the capture-recapture estimator, \hat{N} , as an estimator of total population size,

$$\hat{N} = (\text{FS})/M. \quad (5.1)$$

5.D.3. Application to PEP

A simple extension of the capture-recapture estimator to the results of the PEP matching would be to treat the census as the first source and the P sample as the second. The census count, N_c , corresponds to F in figure E; the weighted sample total from CPS, N_p , corresponds to S; and M is the weighted sample estimate of the number matched between the two sources. In the revised notation

$$\hat{N} = (N_c N_p)/M. \quad (5.2)$$

Use of weighted estimates for N_c and M in (5.2) extends model (5.1) by viewing the census as a "sample" of the population in the sense of an attempt to capture the population, and the weighted CPS estimates N_p and M as the result of hypothetically carrying out the CPS procedures on all housing units and special places in the frame. The actual CPS sample is viewed as a subsample of this hypothetical realization of the CPS on the entire frame.

Important further refinements of (5.2) were necessary for application to PEP. These refinements were all related to restricting and clarifying the concept of being "captured" in the first sample, i.e., in the census. In formula (5.2), the number of people captured by the census is equated to the census count. In order to develop a count of enumerations of persons in the census who could potentially be matched if the same persons had fallen into the P sample, four exclusions from the count are required.

- (a) Additional enumerations of the same persons in the census through duplication must be excluded, since extra enumerations raise the census count without increasing the number of persons who could be matched in the second sample.
- (b) Definitional erroneous enumerations must be removed from the count, because these enumerations could not be matched. In a few cases, the erroneous enumeration involved a complete fabrication, so that there

could never have been a matching person in the P-sample universe. In many cases, the erroneous enumeration corresponded to a real person who did not belong at the address.

- (c) Enumerations of persons at the correct address in an incorrect ED outside of the P-sample area of search also need to be omitted. Even though these enumerations may have been correct in all other ways, such geocoding errors prevented any possible match to a P-sample case.
- (d) As described in section B, substitutions for noninterviews were included in the census count whenever the basic demographic information could not be obtained for these households. Such substitutions represented about 1.4 percent of the total count. Since the missing demographic information would have been required to establish a match to a P-sample case, all such cases were treated as unmatchable.

As described in section 5.C, estimates of the first three of these categories were produced by the E sample. Let EE denote the estimated total erroneous enumerations from the E sample. Direct counts of the fourth group, denoted II, were available from the census itself. The basic dual-system estimator used for PEP was of the form:

$$\hat{N} = (N_c - \text{EE} - \text{II}) N_p/M. \quad (5.3)$$

These adaptations of the dual-system estimator adjust for unmatchable cases and duplications in the census. In the P sample, there were also a considerable number of unmatchable cases, in which no firm determination could be made as to whether the case could be matched or definitely could not be matched to the census. As an example of such cases, those with incomplete PEP followup interviews could not be definitely classified as matched or nonmatched, since these cases lacked the followup information that had proved essential in correctly determining the match status of followup cases.

The approach used for P-sample incompleteness was to apply specific sets of alternative assumptions about missing data

in the estimation of N_p and M. These adjustments are described further in chapter 6, section C. Thus, in contrast to removal of incorrect or unmatchable census cases, EE and II, from N_c in (5.3), unmatchable or otherwise incomplete P-sample cases are instead reflected in the estimation of N_p and M.

5.D.4. Stratification

In instances in which the probability of being caught in the first and second samples potentially varies over identifiable population subgroups, Chandrasekar and Deming⁵ recommended dividing the population into strata within which the capture probabilities could be assumed to be more homogeneous than in the whole population. The dual-system estimates presented in this report, unless otherwise noted, employ a stratification by State, age (five-year age groups), sex, and race/ethnicity (non-Black Hispanic, Black Hispanic, Black non-Hispanic, White non-Hispanic, and other non-Hispanic). Collapsing rules specified grouping of cells together across age, sex, and race/ethnicity combinations to include at least 20 P-sample cases in each application of (5.3).

5.D.5. Assumptions of the Dual-System Estimator in PEP

Among others, Seltzer, Marks, and Krotki⁶ and Wolter⁷ have enumerated the assumptions of the general dual-system estimator. The specific assumptions underlying application of (5.3) to the PEP are as follows.

- (a) The number of distinct persons correctly enumerated in the correct ED or within the effective P-sample area of search and who are recorded with adequate information for purposes of matching is assumed to be estimated by N_c minus the sum of II and EE within each of the stratification cells employed in the dual-system estimator.

⁵C. Chandrasekar, and W. Edwards Deming, "On a Method of Estimating Birth and Death Rates and the Extent of Registration," *op. cit.*

⁶Eli S. Marks, William Seltzer, and Karol J. Krotki, *op. cit.*

⁷Kirk M. Wolter, "Some Coverage Error Models for Census Data," *op. cit.*

- (b) For each complete case, the combined effect of the original CPS interview and the followup interview, if necessary, is assumed to have resulted in the information necessary for matching to the census, i.e. adequately represented name and demographic characteristics and geographic information on Census Day address sufficient to define a P-sample area of search containing the correct ED.
- (c) Whenever adequate information was judged to be available in the P-sample for purposes of matching, the clerical matching is assumed to have occurred without error, neither falsely matching cases that should not have matched, nor failing to match cases that should.
- (d) The assumptions about missing data in the P sample and the nonresponse adjustments in which the

assumptions are reflected yield estimates N_p and M representing the effect of matching to the census, if matching had been possible for the entire population represented by CPS in the absence of missing data problems.

- (e) Within each stratification cell, the underlying match rate estimated by M/N_p is essentially identical (ignoring finite population effects) to the rate $(N_c - EE-II)/N$ at which the census correctly captures unique individuals within their P-sample area of search.

The last of these assumptions represents a general notion that census coverage and CPS coverage are statistically independent processes. Because the given population is finite, exact statistical independence generally could not occur for a

given realization of the census. Wolter⁸ and others have given more precise statements of the last assumption through superpopulation models considering the realization of the census to be a random variable. Similar motivation for PEP would appear possible but require considerable extension to represent the complex nature of CPS and census coverage. Alternatively, this last assumption can be viewed in practical terms as a simple statement about the approximate equality of proportions, namely, that the CPS universe within a stratification cell provides an estimate of the capture rate of the census with negligible error.

Specific methodological issues related to the suitability of these assumptions for PEP are discussed in the next chapter.

⁸Kirk M. Wolter, "Some Coverage Error Models for Census Data," *op. cit.*

Chapter 6.— Methodological Limitations of the PEP

6.A. OVERVIEW

Section D.5 of the previous chapter listed five assumptions underlying the application of dual-system estimation to the PEP. In this chapter, specific discussion is devoted to how each of these assumptions failed or may have failed. Most of the following sections summarize an issue or analysis that is presented in more detail in the PERM series or another source.

The presentation in this chapter focuses first on overriding issues. Section 6.B examines the question of matching and possible sources of matching error, since matching is the critical operation in dual-system estimation. A discussion of the problem of missing data in the P and E samples follows next: missing data represented a key issue in the interpretation of the PEP.

The later sections of the chapter treat more specialized topics. Section 6.E concerns possible errors in matching persons who moved between Census Day and the CPS interview. Section 6.F evaluates evidence on whether inclusion in CPS influenced the sampled person's chances of inclusion in the census. Section 6.G discusses possible errors in E-sample data obtained from Post Office respondents, and section 6.H lists some other possible sources of error.

These sections provide a review of each of the five assumptions listed in section 5.D.5. The first assumption concerned N_c -II-EE as an estimate of matchable persons correctly captured by the census. Section 6.D discusses the importance of the treatment of missing E-sample data in the estimation of EE, overall erroneous enumerations. Section 6.G describes the difficulty in measurement of one specific component of the erroneous enumerations.

The second assumption stated the requirement that adequate information be available for purposes of matching for cases classified as complete in the P sample.

Section 6.E examines the particular difficulty posed by movers in obtaining an adequate Census Day address.

Section 6.B deals with the third assumption, that matching occurred without error.

The fourth assumption required that the missing data assumptions correctly represent the outcome of attempting to match incomplete P-sample cases to the census if instead adequate information had been available for matching. Section 6.C lists the major categories of missing data in the P sample and states alternative assumptions and their possible limitations.

Section 6.F illustrates one means by which the independence assumption may have been violated.

Section 6.H concludes by reviewing the assumptions and mentioning additional possible methodological limitations.

6.B. MATCHING ERRORS

The third assumption listed in section D.5 of the previous chapter was that clerical matching occurred without error for all P-sample cases judged to have adequate information for matching. Two types of errors were assumed not to have occurred: false matches of nonmatching cases and false nonmatches of matching cases.

False matches of nonmatching cases may be divided into

1. instances in which a match of a P-sample case was made erroneously to the enumeration of another person, but a match to the actual enumeration should have been made instead, and
2. instances in which no match should have been made.

The former case is not serious since the case would have been correctly classified as a match to the census. In the second case, however, the number of nonmatches in the census becomes understated.

False nonmatches to the census, on the other hand, have the effect of overestimating the nonmatch rate. Because of the sometimes difficult nature of the matching work, false nonmatches probably represent a greater concern than false matches.

The design of the matching operation included a number of quality control procedures that attempted to limit both types of error. To prevent false matches, matching rules were quite strict at the preliminary stages and referred more difficult cases to higher level professional staff. For example, the first attempt required an exact match on name, date of birth, and at least one other demographic characteristic. Successive stages of matching permitted more flexibility but remained within guidelines. A quality check followed each match. PERM 130 discusses the levels of P-sample matching in greater detail.

Prevention of false nonmatches rested primarily on redundancy. Cases judged to have adequate information for matching actually went through several attempts at matching, often as many as five or six, if necessary, before being declared a nonmatch to the census. For a given case, each separate attempt to match was almost always performed by a different staff member.

In spite of its central importance to the study, only a limited amount of quantifiable information exists on the quality of matching. Cowan¹ reported on a study of PEP matching using professional staff not otherwise involved in the matching to rematch independently a sample of PEP cases. Rules for matching were not strictly specified but approximated those used in the final levels of P-sample matching. The sample for the study was drawn disproportionately from cases classified as nonmatches

¹Charles D. Cowan, Memorandum for Charles D. Jones, Chief, Statistical Methods Division; Subject: Results of a Box Search Experiment for PEP, U.S. Bureau of the Census, March 27, 1981.

in PEP. Among cases classified as matches in PEP, but not so identified to the staff of the study, approximately 10 percent, 12 out of 114, were not matched in the study. This high nonmatch rate for previously matched cases may have been a consequence of the advantage due to redundancy in the original effort compared to the single matching attempt in the study. Conversely, the study staff matched almost 5 percent, 20 out of 455, of cases classified as nonmatches in PEP. This error rate, although not extremely high, would imply some upward bias in the nonmatch rate, if the rate of false matches were actually negligible.

6.C. MISSING DATA IN THE P SAMPLE

6.C.1. Principal Types of Missing Data

The P sample contributed the factor N_p/M , the reciprocal match rate to the census, to the capture-recapture estimator (5.3) described in section 5.D. The formulation of this capture-recapture model presupposes all P-sample cases to be classified either as "matched" or "nonmatched." The conduct of the PEP resulted in a substantial number of P-sample cases with incomplete outcomes in the matching, however. These cases came to be known as "unresolved cases." How these incomplete data are treated with respect to the capture recapture model has major implications in the interpretation of the PEP results. The discussion in this section distinguishes five major categories of missing data in the P sample:

- (a) those household noninterviews in the CPS for which matching was not attempted, or for which any results of attempted matching were set aside;
- (b) persons in noninterview households in the April CPS with a presumed Census-Day address, who were not matched to the census, and for whom no followup was ever attempted;
- (c) incomplete followup interviews for persons not matched to the census in the initial matching effort;

- (d) persons with completed followup interviews for whom the ED appropriate for the Census-Day address could not be ascertained; and
- (e) a residual category of remaining sources of missing data.

This section briefly describes each of the first four sources of missing data. PERM 123 provides a more detailed discussion, including description of the residual category.

The household noninterviews that occur in the conduct of the monthly CPS represent a principal source of incomplete data for PEP. The 5.3 percent of the occupied housing units in sample but not interviewed in the August CPS remained as incomplete cases in the PEP.

Household noninterviews constituted a slightly smaller proportion, 4.4 percent, of the April CPS sample. Two different treatments of this group were considered in the analysis. One was to treat all CPS household noninterviews as incomplete data. As described in section C of chapter 5, the alternative treatment of them was to consider information from the March or May CPS on their household composition for purposes of matching to the census. Approximately 72 percent of the April CPS noninterview households were included in this matching, leaving only 1.2 percent of the April PEP as complete household noninterviews. Cases that were matched to the census were accepted as complete data under this alternative. Cases not matching were considered incomplete and included in a separate procedure described in the next subsection.

In addition to household noninterviews from the CPS, several other circumstances led to incomplete data in the P sample. Two basic situations predominated, however. One of these pertained to incomplete followup interviews. When CPS cases underwent the initial clerical match without a successful outcome, they were assigned to a followup interview. For many, the interview was incomplete, generally because the assigned interviewer was unable to contact the designated respondent. In some cases, unfortunately, the interviewer accepted information from a respondent ineligible under the rules for followup without properly attempting to reach the appropriate respondent; these cases were also classified as incomplete. Although the followup

design included provision to obtain the current addresses of respondents who had moved in order to attempt to contact and to interview them there, this effort also was only a partial success. Overall, approximately 22 percent of the assigned followup interviews for the April CPS sample were incomplete. The corresponding rate for the August CPS was 19 percent. Incomplete followup interviews represented 2.6 percent of the total April sample and 2.8 percent of the August.

Subsequent analysis of the PEP data was performed in conjunction with data collected by the CPS in later months for the same sampled housing units to determine the extent to which this high nonresponse may have been due to moving. The results, presented in PERM 124, indicated that the predominant difficulty in completing followup interviews was that respondents had moved between the original April or August 1980 CPS interview and the time of PEP followup generally 6 months to a year later.

A second important, although smaller, class of cases represented persons for whom a followup interview had been obtained, but for whom the resulting information on the correct Census Day address was inadequate to provide a basis for a match to the census. In a few instances, these persons lived at the same address on Census Day as the CPS sample address, but the information obtained on the location of the CPS address with respect to the geographic boundaries in the 1980 census was insufficient. Almost exclusively, however, these incomplete cases were "movers" reported to have a Census-Day address different from the CPS sample address. In some cases respondents refused to give or reported not knowing the correct Census-Day address. In other instances, the followup interviewer may have believed that the reported address was satisfactory, but it later proved inadequate to determine the precise location when attempting to match to the census.

Incomplete followup cases and cases with insufficient geographic information constituted the two primary contrasting problems in missing data for interviewed households. Other missing data situations also arose, but each of these other situations was treated as analogous to one of

these two primary situations of missing data. PERM 123 describes these other situations in detail.

6.C.2. Treatment of Missing Data

Matching studies of undercoverage in earlier censuses also confronted problems of missing data. While matching most cases to the census and identifying a group of confirmed nonmatches, these studies were also left with a residual category of cases that remained unmatched to the census but lacked sufficient confirming evidence for an unambiguous classification as a census miss. Typically, the approach taken was to omit the residual cases from the analysis, thus basing the estimates only upon cases that could be firmly classified as matched or missed. Results from this approach applied to the April P sample are presented in chapter 7 as one of the alternative assumptions about missing data.

Using only completed cases to form the dual-system estimates in effect assumes that incomplete cases would have the same match rate to the census as complete cases. To the extent that missingness may be associated with the ability to match to the census, analysis of only complete cases would be biased. The majority of the P-sample estimates in this report instead employ a model for the relationship between the incomplete cases and the match rate. To the extent that this model also may have failed to represent correctly the relationship between missingness and match rate to the census, the resulting estimates would again be biased. A further discussion of the properties and potential limitations of the model for missing data is included in PERM 123. This section will describe how the model was implemented and the nature of the underlying assumptions.

The implementation of the model used a combined strategy of incorporating some of the adjustments for missing data into the survey weights and imputing match status to the remaining cases with missing data on the basis of completed cases judged to be similar.

A common method for compensating for complete nonresponse is through weighting adjustments, in which the weights of nonresponse cases are proportionally redistributed among the weights of the other cases. For example, in the estimation of

monthly labor force characteristics in CPS, the sample weights of noninterview households are proportionally redistributed among interviewed households through a noninterview adjustment. The adjustment is applied separately within racial and geographic groupings. In effect, the adjustment assumes that noninterviewed households within the racial and geographic cells have the same characteristics on average as interviewed households.

The treatment in PEP of noninterview households in the August CPS followed this approach of applying adjustments to the weights of interviewed households within racial and geographic cells. In this case, the implicit assumption was that noninterviewed August households within racial and geographic cells had the same match rate to the census as interviewed households.

One treatment of the April CPS noninterviews used a household noninterview weighting adjustment, in the same manner as the August PEP, for all April CPS noninterviews. Again, the implicit assumption was that April noninterview households had the same match rate to the census within racial and geographic groups as households interviewed in the April CPS.

In the alternative treatment of the April CPS noninterviews, the use of March or May information on household composition enabled most of these cases to be successfully matched to the census. Those matching to the census were accepted as legitimate matches, while those for which the attempt to match failed were treated as incomplete data and included in the imputation procedure to be described next.

Most of the remaining incomplete cases received a match status through imputation, which involved assigning the match status to incomplete cases from similar complete cases. Generally speaking, imputation is often used for item nonresponse; for example, imputation was employed in the 1980 census for this purpose. The method of imputation for the PEP depended on specific assumptions about the nature of the missing data. The high nonresponse rate from the followup was viewed as the consequence of attempting to interview a mobile population after six months to a year. Most CPS persons actually in the census were matched in the initial attempt and so were immediately classified as complete matching cases. Only those enumerated persons not initially located were at

risk of becoming missing cases as a consequence of followup noninterview. On the other hand, none of the true census misses would have been classified as complete from the initial matching attempt; instead, this group should have been entirely sent to followup. Because of this design, all census nonmatches were at risk of becoming nonresponse cases in followup, while only approximately 10 percent of the total true census matches were at risk. Consequently, if, among followup cases, incompleteness in the followup interview was independent of true census match status, then the population of complete cases—cases initially matched and cases with complete followup information—would disproportionately include enumerated persons, and the population of incomplete cases—those requiring followup but missing complete followup information—would disproportionately include missed persons.

In the imputation procedure employed for the majority of PEP estimates, cases with incomplete followup interviews were assumed similar to cases that had been sent to followup but that had complete followup interviews. The cases with incomplete followup interviews were therefore assumed to be like a specialized group, since cases with complete followup interviews represented only approximately 9 percent of the original P sample. This procedure reflects the assumption that, for those cases assigned to followup, nonresponse was independent of census coverage. It may be argued, however, that nonresponse and census coverage may have been associated. Indeed, some alternative sets of PEP estimates in effect assume that cases with incomplete followup interviews resembled the complete cases in the P sample as a whole, including the large number of cases matched to the census in the initial match. These issues are discussed further in PERM 123.

In addition to the assumption that nonrespondents during followup were generally similar to completed followup cases, the imputation procedure also reflected the status of the match before followup, and race/ethnicity and other demographic and geographic characteristics. These remaining characteristics considered in the imputation had a relatively modest effect on the overall level of the resulting imputations, as shown in PERM 123.

In the alternative treatment of April CPS noninterviews, cases with household

composition established from the March or May interview but not matched to the census were treated as approximately analogous to cases with incomplete followup interviews, in the sense that an initial attempt to match failed and the information from a followup was not obtained. The analogy is imperfect, however, because the principal group of incomplete followup interviews represented unsuccessful attempts to interview, whereas no followup was attempted for nonmatching persons in nonresponding households in the April CPS. Nonetheless, this group received imputations by the same means as incomplete followup cases.

Cases with incomplete geographic information represented a substantively different situation. Although many incomplete followup cases representing true census omissions had probably been searched for without success in the geographically correct ED's before the followup, few if any of the cases with incomplete geographic information were ever searched in their correct ED. For this group, an alternative approach to the problem of missing data was employed. Again, the approach was based upon imputation and considered whether the cases were reported as movers, since most cases with incomplete geographic information were movers. Unlike the imputation for incomplete followup cases, the imputation for those with incomplete geographic information did not restrict the comparison to complete followup cases only. In other words, movers with incomplete geographic information were matched to movers with complete information, and nonmovers with incomplete geographic information were matched to nonmovers with complete information.

These two different approaches to missing data are based upon a causal model for nonresponse.² PERM 123 describes the underlying model reflected in the imputation procedure, including the interdependence between these two types of nonresponse.

As mentioned earlier, several other, less major categories of incomplete data in the P sample resulted from the PEP operations. These additional categories and their treatment are discussed in detail in PERM 123.

To summarize, for the analysis based upon the April CPS interviewed households only, the household noninterview rate of 4.4 percent may be combined with a rate of 2.6 percent of the interviewed persons who had incomplete followup interviews and a 1.4 percent rate of incomplete data for other reasons. The total of these household and person rates, 8.4 percent, represents a summary measure of incomplete data for this analysis.

By attempting to match April CPS non-interviews with adequate information on the household composition, the household noninterview rate drops to 1.2 percent. Partially offsetting this, however, is the number of cases not matched that must be considered incomplete because no followup interview had ever been attempted. The rate of incomplete data on a person basis is 4.3 percent, giving a combined household and person total of 5.5 percent.

Finally, the 5.3 percent of August households not interviewed in CPS may be added to the person rate of 2.8 percent for incomplete followup interviews and 1.6 percent from other sources, giving a total of 9.7 percent.

Several sections of this report examine issues with respect to twelve different sets of estimates. Variation among these different sets of estimates serves to illustrate a range of possible interpretations of the PEP estimates, in part due to the problems of interpreting missing data in the P sample. Most of these estimates employ the imputation procedures just outlined. The alternative approach of using only the complete cases without imputation is incorporated in three of these sets. PERM 123 further discusses the potential limitations of the imputation model.

6.D. MISSING DATA IN THE E SAMPLE

6.D.1. Types of Missing Data

As stated in section C of the previous chapter, the PEP E sample was selected from the 1980 census to estimate geocoding errors in the census, definitionally

incorrect enumerations, and duplications. The survey procedures for estimating these three components of overenumeration differed considerably by component. Similarly, quite different problems of missing data arose for each component.

There were four principal types of incomplete data in the E sample.

- (a) In a small proportion of cases, the search to measure within-ED duplications was not performed.
- (b) Enumerators could not locate the housing units corresponding to some sampled E-sample enumerations. In these and some other cases, the correctness of census geocoding could not be determined.
- (c) Because of practical difficulties discussed in this section, some between-ED duplicates are not included in the estimates.
- (d) There was a substantial incidence of interview nonresponse resulting in an inability to determine if the original census enumerations were definitionally correct.

These different sources of missing data are described further in this section.

For the measurement of duplications within ED's, a 50-percent subsample was selected from the total E sample for the within-ED duplicate search. The entire ED was searched to find duplicate enumerations of the subsampled households. For less than 0.1 percent of these cases, this search was not performed or was mistakenly performed for a household that had not been sampled as part of the subsample instead of the subsampled household. Thus, there is a small amount, 0.1 percent, of missing data on duplications within ED's.

The sampled households were assigned to E-sample interviewers. Part of the interviewer's responsibilities for each case was to indicate on a map the actual location of the unit. Although this operation was generally conducted in conjunction with the E-sample household interview, the map spotting required only identification of the census housing unit without further cooperation from respondents. Nonetheless, interviewers were unable to find approximately 0.3 percent of the assigned units. This and other reasons contributed to an overall nonresponse rate of almost 1.6 percent for correctness of geocoding.

²Robert E. Fay and Charles D. Cowan, "Missing Data Problems in Coverage Evaluation Studies," *Proceedings of the Section on Survey Research Methods*, American Statistical Association: Washington, DC, 1983, pp. 158-163; and Robert E. Fay, "Causal Models for Patterns of Nonresponse," *Journal of the American Statistical Association*, Vol. 81 (June 1986), pp. 354-365.

As discussed in section C of the previous chapter, the extended search in the P sample among more than one ED forced the E-sample definition of geocoding error to reflect the extended search. As a secondary consequence, duplicate enumerations between ED's in the same area of search should also have been included as erroneous enumerations. For reasons of expediency during the 1981 processing of the PEP, only specific cases were checked for duplications between ED's. It was recognized at the time that the subset on which the check was performed did not properly include all the possibilities for between-ED duplications. Later, a more complete check was performed with the PEP E sample as part of the Housing Unit Coverage Study (HUCS). This study uncovered more between-ED duplicates than the original PEP between-ED duplicate check. This difference arose simply from checking more cases in HUCS than in PEP.

Information is available on most of the duplicates uncovered by HUCS. PERM 119 presents some characteristics of this group, although the results still omit some of the duplicates uncovered by HUCS. None of these HUCS findings are reflected in the dual-system estimates presented in this report. This understatement of duplicates inflates the dual-system estimates by between 0.1 and 0.2 percent, compared to the dual-system estimates that would have resulted from full use of the HUCS findings. Since these errors are generally modest relative to other limitations of PEP, revised estimates were not calculated.

The determination of whether the persons enumerated in the census fully satisfied the definition of correct enumeration required information from respondents. The original census household was the first source at which contact was attempted. For about 0.1 percent of the sample in which the original household refused to be interviewed, the procedures directed the interviewer not to attempt to acquire any further information. As discussed in section C of chapter 5, if the original household had moved away or was temporarily absent, however, the E-sample interviewers were instructed to obtain information from neighbors, rental agencies, or other knowledgeable sources. If no such sources were available or knew the status of the census household, then the E-sample interviewers were directed to seek information from the post office as a last resort. Use of

other sources for respondents who had moved or were temporarily away served to limit the overall rate of household noninterviews to roughly 1.1 percent, lower than the typical rates of household noninterviews for most Census Bureau surveys.

Among the households with interviews, a significant proportion of cases had incomplete data. The E-sample questionnaire was designed to determine whether a person was correctly enumerated through a series of questions. In several cases the interviewer apparently failed to ask all pertinent questions for the case. In other instances, the response to one of the critical questions was "Don't know," again preventing an unambiguous determination of whether the person was correctly enumerated. Approximately 1.9 percent of the persons in households for which a partial or complete interview had occurred had incomplete information on definitional correctness of enumeration.

6.D.2. Treatment of Missing Data

Different strategies were employed to treat the missing data in the E sample. For cases missing data for geocoding, an imputation procedure was used to supply a determination on the correctness of geocoding by matching to a geographically similar complete case. Few cases were ever imputed to the category of "incorrectly geocoded," since most complete cases used in the imputation were determined to be correctly geocoded. The possibility exists, however, that many incomplete cases lacked a determination for geocoding error precisely because they were incorrectly geocoded in the census. In other words, census enumerations with geocoding errors may have been disproportionately difficult to locate compared to census enumerations in the correct ED. Under this latter interpretation, the effect of missing data on the E-sample estimates may have been to underestimate the level of geocoding error even after the imputation for missing data had been performed.

No adjustments were made for missing data on duplications. This decision has relatively minor implications for the measurement of duplications within ED's.

When no information on the definitional correctness of enumeration was obtained for households correctly geocoded in the

census, a weighting adjustment was employed, as described in PERM 126. This adjustment considered demographic and geographic characteristics of persons without any information from the E-sample interview.

Cases with partial interview information for the E-sample interview varied in the extent of reported information available. In some instances the recorded information suggested that the enumeration was probably correct. For example, if it was established that the person lived at the address on census day, a final question asked whether the person had any other address. The typical answer was "no." If this last item were omitted, the enumeration was not established as correct, even though the pattern of responses implied a strong chance of correct enumeration. In other cases, the patterns of responses were instead similar to those for complete cases disproportionately classified as erroneous enumerations. To make use of the partial information, an imputation procedure was employed that matched incomplete cases to complete cases with identical answers on each question for which the incomplete case had a recorded response. For the full set of E-sample data, including responses reported by the post office, approximately 1.9 percent required imputation. Such imputations contributed 30 percent of the total estimated erroneous enumerations, however. This high rate of assignment to the status of erroneous enumeration stemmed from many incomplete cases having patterns of response similar to complete cases that were disproportionately classified as erroneously enumerated. The imputation did not exclude as potential donors any complete cases by design. The patterns of partial response clearly had a strong effect on the resulting imputations. The patterns of response to the E-sample questionnaire and the method of imputation are described in more detail in PERM 126.

6.E. ERRORS IN CENSUS DAY ADDRESSES FOR MOVERS

6.E.1. The Problem of Collecting Census Day Address from Movers

The April and August samples from the CPS selected persons according to where they lived during the latter parts of April

and August, respectively. For the "non-movers," who were the largest proportion of each sample, the CPS address was also the address at which the sample persons should have been enumerated on Census Day, April 1, 1980. The "movers," who had a different Census Day address, formed an important proportion of the sample, however, particularly in August. As described earlier, the basic design of the PEP was to attempt to match movers at their Census Day addresses.

Establishing the correct census ED in which to search for a CPS sample person was often problematic. The difficulties were especially acute for movers, since there were comparatively far more resources available to establish the correct ED's for nonmovers. CPS interviewers prepared sketch maps showing the location of the CPS sample before any matching was attempted. For the nonmovers not initially matched to the census, a second, generally more detailed, sketch map was prepared as part of the followup interview. These sketch maps for nonmovers were an important supplement to the address information, such as street address, normally recorded in the conduct of the CPS.

Except for a very small number of cases, all CPS addresses for nonmovers could be assigned to a census ED, especially after "cleanup" operations conducted in 1982. Movers contributed virtually all of the PEP cases that could not be assigned to a census ED. In some cases, respondents did not know or refused to give their Census Day address. In many instances, however, a reported address proved insufficient to establish the correct ED or even a manageable group of ED's to search.

In addition to problems of missing address, this section discusses evidence suggesting the possibility that for movers a substantial fraction of the reported addresses considered sufficiently complete to search were in fact incorrect or mistakenly coded to the wrong ED. The consequences of such errors would be to overestimate systematically the nonmatch rate to the census for movers. Such a systematic error would in turn have more serious consequences for the interpretation of the August CPS than for April.

Nonmovers in August had an estimated nonmatch rate to the census of approximately 5 percent. The estimated nonmatch rate for movers was in excess of 20 percent. Although this latter figure is quite

high by itself, it is especially so considering that it represents an overall rate for the entire group of persons moving between Census Day and late August. It is natural to assume, and studies of other censuses have confirmed, that persons moving at a time quite close to Census Day are at greater risk of being omitted from the census or of being enumerated at a subsequent address rather than at their correct Census Day address. Any connection between moving in mid- to late summer and census coverage, however, should have been far weaker, since almost all persons have been enumerated by that time. Thus, the nonmatch rate in excess of 20 percent represents an average from a period close to the census date (where significant differential coverage could easily be accounted for) to a later period (where a nonmatch rate substantially different from 5 percent would not be expected).

6.E.2. The Rotation Design of CPS

The CPS sample each month is composed of eight rotation groups, each a separate probability sample of the civilian, noninstitutional population. Housing units selected into the CPS sample are interviewed for four months in succession, omitted from the sample for eight, and then reinstated for four final months. The "month in sample" of a CPS household refers to the number of times the housing unit has been included in the designated sample. Thus, the fifth month in sample for a housing unit occurs one year after its initial interview. Each CPS sample comprises eight rotation groups of almost identical size, where one rotation group is in its first month in sample, one in the second, etc.

6.E.3. Evidence from CPS Rotation Groups on Reported Addresses for Movers

PERM 124 presents in more detail an analysis attempting to investigate indirectly the quality of reported addresses for movers. By taking advantage of the rotating design of the CPS, it is possible to determine approximately the time of the move through comparisons to the CPS samples in May, June, and July for some rotation groups of the August sample. According

to this approximate dating, persons moving close to the time of the census show a higher nonmatch rate than movers moving later in the summer. On the other hand, the observed differentials are quite modest, and the estimated nonmatch rate for movers exceeds 20 percent, even for those apparently moving between the July and August CPS samples. Although the evidence is indirect, it suggests that much of the differential between movers and nonmovers is due to problems in obtaining correct addresses and corresponding ED's for movers. The data are consistent, however, with the existence of some differential undercoverage for movers closer to Census Day. PERM 124 includes tables from which these observations have been extracted. A second analysis based upon the April CPS also appears there, and supports the conclusion that the nonmatch rates for August movers are too high.

6.F. CONDITIONING OF CENSUS COVERAGE BY CPS

The dual-system estimator for PEP assumes statistical independence of census and CPS coverage within demographic and geographic cells. One of the ways in which this assumption may fail, however, arises from possible effects of the CPS itself upon attitudes and behavior of sampled CPS households with respect to the census. For example, exposure to CPS interviewing procedures may have either positively or negatively affected respondents' cooperation with the census. Influence of this sort, termed "conditioning" in this report to indicate that exposure to CPS may effect or "condition" census response, contradicts the assumption of independence.

A direct analysis of impact of the CPS upon census response is not available, but the rotation design of the CPS affords an indirect assessment of possible conditioning. Each rotation group is a probability sample of the population and, therefore, estimates of any characteristic from each rotation group should agree within the bounds of random variation due to sampling. Each of the rotation groups is interviewed under somewhat different circumstances, however. Rotation groups in later months in sample have been exposed to a progressively cumulative effect of interviewing by CPS interviewers. The survey

procedures require personal visit by interviewers for the rotation groups in the first and fifth months in sample; for the remaining six months in sample, the telephone predominates as the usual method of data collection. In the first and fifth month, CPS interviewers are required to obtain a listing of the members of the household from the respondent, but in other months they simply review the listing from the previous month with the respondent to record any changes. If the previous household has left the sampled address, interviewers must obtain a listing of the new household.

Anecdotal evidence suggested two specific mechanisms by which inclusion in CPS could affect census coverage differentially by rotation group in the April CPS. A Census Bureau staff member issued a memorandum directing CPS interviewers to encourage response to the census and to assist respondents in completing their census mail-return forms. The personal-visit interviews of the first and fifth month in sample presumably afforded CPS interviewers greater opportunity to encourage and assist respondents directly with their census mail return forms than would the CPS telephone interviews predominating in the other months. Consequently, this might manifest itself through apparently better census coverage of the first and fifth months in sample than other rotations.

A second possible effect of inclusion in the CPS on census coverage was a potential for confusion between participation in CPS, a sample survey conducted by the Census Bureau, and response to the census itself. In the followup interview of CPS cases not initially matched to the census in PEP, several respondents reported not completing their census forms because they thought their response to CPS was sufficient. This confusion presumably would have been essentially restricted to the six rotation groups of the April CPS that had also been interviewed in the middle and end of March, just before they received their census forms by mail in late March. Thus, these persons could have been directly influenced by the March CPS interview in their decision to complete their census mail return form in the critical first two weeks of April in which most households responding by mail complete their forms.

In fact, the pattern predicted by each of the two preceding explanations, that the first and fifth months in sample would

have lower than average nonmatch rates, appears in the April data. The two explanations have different interpretations of the bias, however. In the first, CPS interviewers' assistance, concentrated on the first and fifth rotation groups, led to a bias towards high rates of match to the census. In the second, adverse effects of inclusion in the March CPS caused a downward bias in the match rates to the census for the remaining six rotation groups.

This correspondence between the observed relative levels of the nonmatch rates by rotation group and the predictions made by the preceding two explanations for possible conditioning effects suggests that one or both factors did indeed affect the PEP data in April. Whether one of the two factors was the more important is not completely clear from this analysis. PERM 129 presents the data upon which these comparisons have been made and further discusses the evidence on this question, including an analysis of the mail response rates of the separate rotation groups.

Because of the overlap in timing between the April CPS and the census, effects of conditioning of CPS are quite plausible. Considerations of timing do not suggest the same degree of possible effects of the August CPS upon census coverage as in April. The May CPS sample, in mid- to late May, was the earliest sample in 1980 to include any of the rotation groups comprising the August sample. The May CPS interviewing occurred after the census enumeration of persons was largely complete. Nevertheless, part of the census enumeration still remained to be finished during some of the period in which rotation groups from the August CPS were interviewed. Furthermore, half of the designated sample housing units in the August CPS had been included in the sample during 1979. Thus, effects of conditioning on the results for the August CPS are certainly possible but not as directly obvious as those for April.

6.G. DATA COLLECTED FROM POST OFFICES IN THE E SAMPLE

The E sample was responsible for including as erroneous enumerations "curbstoned" cases fabricated during followup by some census enumerators, contrary to all accepted procedures. (The term "curb-

stoning" refers to an enumerator making up data while "sitting on a curbstone," but applies generally to any falsification of data.) The identification of curbstoned cases was necessarily quite dependent on the quality of reporting by the post office.

As explained in the previous chapter, E-sample interviewers obtained most data on the correctness of census enumerations from occupants of the original census housing units. In most such cases, the respondent was a member of the original census household, but in some instances the respondent was a member of a replacement household moving into the housing unit after the original census household had left. In some cases, however, no member of the original household could be reached and subsequent occupants, if any, could not provide information about the composition of the Census Day household. In these instances, E-sample interviewers were next instructed to obtain information from a knowledgeable respondent such as a neighbor or rental agent. If the alternative source reported not having known the person or persons in the enumerated census household, then information was sought from the post office as a last resort.

The first method for determining from the post office whether the E-sample person had lived at the address on April 1, 1980 was to check if the household had filed a change-of-address form. The filing of such a form for a date after April 1 was accepted as documentary evidence that the person or persons had lived at the address. A very small number were declared to be erroneous enumerations when the date preceded April 1.

In the absence of a change-of-address form, the postal carrier on the route was asked if the person or persons had received mail at the address, and, if so, when. Responses of "yes" to this question were treated as correct enumerations, "no" as erroneous enumerations, and "don't know" as incomplete data.

Cases of erroneous enumerations and incomplete data from this last question on the post office section of the questionnaire were concentrated disproportionately among enumerations classified as Black and Hispanic. For these groups, erroneous enumerations determined on the basis of responses from the post office were a significant proportion of the total estimate of erroneous enumerations. It is thus natural to

question whether this approach to estimating erroneous enumerations led to a systematic overestimate. It was possible that many persons might be unknown to neighbors and the post office, yet still have been properly enumerated at the address.

An alternative approach was also employed to analyze the data in this report, namely to treat all cases referred to the post office, including those with change-of-address cards, as instances of missing data. The effect of the missing data procedures in this analysis was to treat almost all such cases as correct enumerations.

This second approach clearly avoids the danger of treating too many of these cases as erroneous enumerations, but risks underestimating the number of erroneous enumerations instead. Because of the pattern of questioning and directions to interviewers on the E-sample questionnaire, all enumerated persons completely fabricated by census enumerators would necessarily have been referred to the post office for resolution. Because no change-of-address form would have been filed for fabricated persons, all such cases would finally be referred to the postal carrier and depend on an answer of "no," or, less satisfactorily, "don't know" to the question of whether the person lived at the address. To the extent that curbstoning did occur in the census, the alternative approach of treating all cases referred to the post office as incomplete data would virtually entirely fail to measure it.

Thus, the two alternative analyses bound the uncertainty in interpreting the data from the post office by probably overestimating the true number of erroneous enumerations in one case and probably underestimating it in the other. PERM 127 discusses an analysis furnishing some evidence on the relative merits of these two interpretations of the data from the post office. The census forms contain an indicator of whether the household had responded by mail to the census in mail areas. In mail areas, almost all fabrication of nonexistent persons would have occurred during census followup, since almost no incentive exists for the fabrication of mail-response households, except perhaps as pranks in isolated instances. Thus, if the post office had properly identified a group of curbstoned households, they would have appeared almost entirely as not responding by mail. On the other hand, if post office clerks and carriers were, in general, indiscriminately identifying actual persons as not receiving

mail at the address, then these persons would have presumably had a mail response rate somewhat, if not entirely, like the average. Thus, the mail response rate provides indirect evidence on the relative validity of the two interpretations of the data.

PERM 127 presents detailed findings of the analysis of mail response. In short, however, 72 percent of households identified as not living at the address were mail nonresponse households. This very strong relationship suggests that post office clerks may have correctly identified many curbstoned enumerations in the census. Nonetheless, the number of mail-response households identified as not living there by the post office was considerable, and suggests that the post office also erred in many cases.

Consequently, it appears that the actual number of erroneous enumerations among cases referred to the post office probably lies in between an interpretation of the responses as correct and a treatment of all such responses simply as missing data. PERM 127 discusses the difficulties of developing a response model to deal effectively with the complexities of this situation.

6.H. OTHER LIMITATIONS

6.H.1. Introduction

Sections B through G of this chapter each summarized specific methodological concerns that affect the assumptions underlying the application of dual-system estimation to PEP. This section adds several other issues to the list and notes, whenever appropriate, where further discussion of these topics appears in PERM reports.

The next chapter presents twelve sets of dual-system estimates. Some of the differences among the sets of estimates originate from the use of different samples, namely, the April or August P samples, but, for the most part, variation among the twelve sets reflects differences in assumptions relating to some of the limitations mentioned in this chapter. This section describes how specific limitations are reflected in the variation among the 12 sets of estimates.

6.H.2. Assumption 1: Consistent Estimation of Matchable Cases

The first assumption listed in chapter 5, section D.5, was that number of matchable and correct cases in the census is

estimated by N_c -EE-II, that is, the census count with the estimated number of erroneous enumerations and substituted households subtracted. Section D of this chapter described missing data in the E sample, the treatment of which affects the estimation of EE. Two different general treatments are reflected in the sets of estimates, thus affording some indication of the effect of the assumptions about missing E-sample data on the interpretation of the PEP.

Section G discussed the specific difficulties in interpreting the information collected from the post office and described two different analyses of these data. Some of the alternative estimates in the next chapter are based on one of these assumptions and others on the second.

Additional methodological difficulties arise in the interpretation of the E-sample data, but these problems are not indicated by differences among the twelve sets of estimates. For example, the estimation of geocoding errors in the E sample, required to measure the otherwise correct enumerations in the census that could not have been matched to the P sample, depended on operationally simulating the construction of the P-sample area of search rather than explicitly defining the area. To the extent that this procedure may have failed in its intent, biases in the dual-system estimator would have resulted. PERM 130 describes the procedure in greater detail, and PERM 119 presents the geographical distribution and other characteristics of the estimated geocoding errors.

In addition to difficulties from missing data in the estimation of definitional errors of enumeration, some level of response error presumably occurred in the measurement of this quantity for complete cases. No explicit response error model is investigated in this report, however. PERM 126, through the discussion of the detailed response and nonresponse patterns to the questionnaire, offers some suggestion of possible difficulties that the E-sample interview may have posed to respondents.

6.H.3. Assumption 2: Adequate P-Sample Information to Match

The second assumption was that, for P-sample cases classified as complete, the

available information was adequate to determine correctly if the P-sample case was enumerated within the correct ED or area of search. Section E discussed evidence suggesting that the Census Day addresses provided for movers may have been insufficient or incorrect among some of the P-sample cases classified as complete. One set of estimates presented in the next chapter attempts to show a possible range for the effect of response error in Census Day address for August movers by omitting them from the analysis.

The P-sample information available for matching may have been deficient in other ways. In spite of the resources available to code CPS addresses to census geography, nonmovers may have also been incorrectly coded in some instances. Furthermore, some persons classified as nonmovers may have in fact been movers, that is, may have had a Census Day address different from the CPS address. The alternative estimates presented in the next chapter do not illustrate the possible effects of these errors.

6.H.4. Assumption 3: Error-Free Matching

Section B discussed the third assumption, that clerical matching was free from errors, both of erroneous matches and of erroneous nonmatches. Although this is a critical

assumption for application of dual-system estimation to PEP, none of the twelve sets of estimates incorporates alternative assumptions. Further discussion of the evidence on the quality of matching appears in PERM 130.

6.H.5. Assumption 4: Correct Modeling of Missing P-Sample Data

The fourth assumption was that the missing data model for the P sample would correctly represent the outcome of matching for incomplete cases if adequate information for the purpose of matching had been available. Section C discussed three conflicting assumptions that could be made about missing data. Each of these assumptions is reflected in some of the twelve sets of estimates.

Although the three sets of assumptions produce wide variation among the resulting sets of estimates, other assumptions may have instead been appropriate. PERM 123 discusses in greater detail the circumstances and types of missing P-sample data, in part to suggest a range of other possible assumptions that may have been reasonable.

6.H.6. Assumption 5: Approximate Independence Between CPS and Census Coverage

Section F discussed one way in which the fifth assumption, that there was approximate independence between CPS and census coverage, may have failed: possible conditioning effects of the CPS on census coverage for households in the CPS sample. No alternative sets of dual-system estimates have been prepared to illustrate this effect, however.

Beyond the effects of conditioning, however, is a fundamental lack of independence between CPS and census coverage, even within the given demographic and geographic cells comprising the stratification for the dual-system estimator. In other words, for some demographic groups, particularly adult males, there is a stronger tendency for the same persons to be covered by both the census and the CPS than implied by the hypothesis of statistical independence. Conversely, persons missed by the census also appeared to have been disproportionately missed by CPS. These conclusions are further discussed in chapter 8, which compares the results of demographic analysis and of PEP.

In spite of the importance of the independence assumption to the dual-system estimator, none of the twelve sets of estimates examines alternative assumptions. Thus, chapter 8 provides the principal discussion of this issue.

Chapter 7.—PEP Estimates of Census Undercount

7.A. FORMATION OF TWELVE SETS OF ESTIMATES

This report presents twelve sets of dual-system estimates based on the data from PEP. The dual-system estimator (5.3) incorporates estimates from both the P and E samples. Each of the twelve sets arises through the selection of one out of five P-sample sets and one out of three E-sample sets. Three out of the fifteen possible sets were not studied, however, because they would have added little to the information available from the twelve.

The purpose in examining different P-sample and E-sample sets and the associated dual-system estimates is to illustrate the effect of some of the assumptions upon the interpretation of the results. As noted in section H of the previous chapter, there are additional assumptions not assessed by comparisons among the twelve.

Three sets of P-sample estimates are based upon the April data. The differences among the three sets are described more fully in section C of the previous chapter. The three sets are:

1. set 2, employing the combined weighting and imputation procedure for missing data and including the results of attempting to match CPS type A non-interview cases where possible;
2. set 3, employing the same approach to missing data but treating all CPS type A cases as PEP noninterviews; and
3. set 14, using a weighting approach to all cases of incomplete data and including all matched type A cases as complete data.

The remaining two sets of P-sample estimates were derived from the August sample. Differences between these two

sets indicate the possible effect of response error from August movers, as discussed in section E of the previous chapter. The two sets are:

1. set 5, methodologically analogous to the April set 3, which includes the result for movers and the treatment of missing data for movers discussed in chapter 6, section C; and
2. set 10, similar to set 5 but deleting all results for movers, both those with complete and those with incomplete data.

The three sets of E-sample estimates involved different assumptions in the estimation of definitional errors of enumeration. The treatment of duplications and geocoding errors was the same in each. The sets are:

1. set 8, based upon the imputation procedure for incomplete data and including all responses from post office personnel;
2. set 9, using the same imputation procedure but treating all responses from post office personnel as incomplete data; and
3. set 20, handling all incomplete data on the definitional correctness of enumeration through a weighting adjustment that did not reflect any partial data that may have been collected for the case.

Dual-system estimates are denoted in this report according to the P- and E-sample sets used in their calculation. The sets studied are: 2-8, 2-9, 2-20, 3-8, 3-9, 3-20, 5-8, 5-9, 10-8, 14-8, 14-9, and 14-20.

7.B. NATIONAL ESTIMATES BY RACE AND ETHNICITY

7.B.1. Estimates for the Total Population

Table 7.1 presents national estimates of percent undercount for the total noninstitutional population, and for Blacks, non-Black Hispanics, and others. The sets of

estimates in table 7.1 are displayed in increasing order of the estimated percent undercount for the total noninstitutional population. This arrangement accents the range of the estimates and the extent to which the estimates for the three race and ethnicity groups move or fail to move in parallel with the estimates for the total population. Table 7.2 displays these same estimates in an alternative form, emphasizing the effect of methodological comparisons among the sets.

Approximate standard errors are given in the last two rows of table 7.1. The range given by the twelve sets of estimates for the national undercount is quite wide, from an estimated overcount of 1.0 percent to an estimated undercount of 2.1 percent. This variation is much larger than the effect of sampling error, since the standard error is only approximately 0.15 percent, rounded to 0.2 percent in the table.

PERM 122 reports findings for the institutional population. The sampling and estimation for the institutional population was conducted separately in the PEP. The primary result was an estimate of the undercount of the institutional population of approximately 4.0 percent, with a standard error of 1.9 percent. Results for the institutional population are otherwise excluded from the discussion in this chapter.

7.B.2. A Technical Note on the Statistical Basis for the Methodological Comparisons

The effect of sampling error is an important consideration in comparing different sets of estimates in tables 7.1 and 7.2. In general, differences small enough to be attributed to sampling error alone cannot be assumed to have arisen from methodological reasons. For example, the difference between the estimated 1.5 percent

undercount from 2-9, which uses the April P sample and one choice of E-sample methodology, and 1.7 percent undercount from 5-8, which uses the August P sample and an alternative E-sample methodology, is within the range of random variation. Consequently, there is insufficient evidence to assume that the methodology underlying the 5-8 estimates gives a higher expected value over repetitions of the August CPS and E sample than the expected value of the 2-9 estimates over repetitions of the April CPS and E sample.

Because many of the sets are based on the same selected samples, there are substantial covariances between many of the estimates. For example, all estimates are based on the same E-sample selection and identical estimates of geocoding error and duplication. The shared use of the E sample induces a covariance between any of the twelve estimates for the national population or for any given race or ethnicity group. Even more important, however, is the common use of the same P sample for sets based on 2, 3, or 14 or for sets based on 5 or 10. Because of these covariances, much smaller differences between estimates are statistically significant than would be the case if the estimates were statistically independent. Unless specifically noted, differences discussed in this chapter are statistically significant when appropriate allowances for covariances have been taken into account.

7.B.3. Comparison of National Estimates

Table 7.1 shows that three sets of estimates imply a national overcount; each of these is based on set 14 combined with one of the E-sample sets. Set 14 represents one of the three treatments of missing data in the April P sample, while the other treatments of the April P sample produce estimates of census undercount of 1.0 percent or more. This comparison clearly shows that the effect of alternative assumptions about missing P-sample data is the single most important factor represented by the variation among the twelve sets of estimates. By keeping the same E-sample methodology but varying the P-sample treatment of missing data, 14-8 at

-1.0 percent differs from 2-8 at 1.1 percent by 2.1 percentage points, approximately two thirds of the range of 3.1 percentage points for all twelve estimates.

Estimate 10-8 is the next lowest at a 0.3 percent undercount. This estimate may be compared to 1.7 percent for 5-8; both employ the same E-sample set but are based on different interpretations of the August P sample. Set 10 is distinguished from set 5 by omitting any data for movers. Thus, this comparison indicates that nonmatch rates for movers considerably influence the August results.

Tables 7.1 and 7.2 show that the distinction between set 2 and set 3 accounts for relatively small differences in the estimated undercount when the same E-sample data set is used. The estimate from 2-8, 1.1 percent, barely exceeds 1.0 percent from 3-8, and similarly 2-9 at 1.5 percent may be paired with 3-9 at 1.4 percent, and 2-20 at 1.9 percent with 3-20 at 1.7 percent. (Nonetheless, the differences between set 2 and set 3 are statistically significant.)

Although set 3 for April and set 5 for August are methodologically analogous, the resulting dual system estimates differ beyond sampling error. Estimates based on set 5 exceed set 3 counterparts by about 0.7 percentage points: 1.7 percent against 1.0, and 2.1 against 1.4, for 5-8 vs. 3-8, and 5-9 vs. 3-9, respectively.

Dual-system estimates based on set 9 exceed those based on set 8 by 0.4 to 0.5 percentage points. The consistency of this difference is readily apparent from table 7.2. Because they omit data from post office respondents, the set 9 estimates imply lower estimates of definitional errors than set 8.

Table 7.2 also shows that the alternative treatment of E-sample missing data, set 20, produces estimates of census undercount higher than those for set 9 by about 0.3 to 0.4 percentage points.

Table 7.2 displays many of the estimates twice in order to illustrate the effect of choice of methodology for both the P and E samples separately. It is evident from this table that most of the information may be conveyed with less repetition. In general, changes in the choice of estimates from the P or E samples have approximately additive effects. In other words, by defining the effect of the choice between two P-sample sets as the percentage point difference in the estimated undercount for a fixed E sample, the resulting effect is

essentially the same regardless of which E sample is selected for the comparison. Similarly, the effect of the choice among E-sample alternatives is virtually the same over different P-sample sets. Recognition of this approximate additivity facilitates further discussion and presentation of the dual-system estimates.

7.B.4. Estimates by Race and Ethnicity

Tables 7.1 and 7.2 indicate that many of the relations among alternative dual-system estimates for the total noninstitutional population also hold for Blacks, non-Black Hispanics, and others separately, although some distinct patterns also emerge.

Again, the contrast between P-sample sets 14 and 3 is quite dramatic, accounting for approximately a 4.6 percentage point shift for Blacks, a 4.4 to 4.5 percentage point shift for non-Black Hispanics, and a 1.3 percentage point shift for others. (The difference in the amount of shift for Blacks and for non-Black Hispanics is not statistically significant.) The effect of the interpretation of missing data is consequently especially striking for Blacks and non-Black Hispanics.

The effect of August movers is also important for all three population subgroups; for the comparison of set 10 and set 5 the effect is 1.7 percentage points for Blacks, 2.9 for non-Black Hispanics, and 1.3 for others. (The difference between the shifts for Blacks and for others is not statistically significant.) For Blacks and non-Black Hispanics, the effect of missing P-sample data represented by the comparison of sets 14 and 3 predominates as the most important single difference among the twelve sets of estimates, whereas for others the contrast between set 10 and set 5 is of approximately equal importance to the contrast between 14 and 3.

Differences between sets 3 and 2 remain fairly small for each group: 0.4 percentage points for Blacks, 0.2 for non-Black Hispanics, and close to no difference to 0.1 percentage point difference for others. (Differences of each group are significantly greater than 0, but there is no statistically significant difference between the shift for

non-Black Hispanics and the shift for either other group. The difference between Blacks and others is significant, however.)

Comparisons between sets 3 and 5 are affected by considerably more sampling variability than other comparisons, since two sets are based on different samples. Contrary to the pattern for the total population, the August set 5 estimates for Blacks fall below the corresponding set 3 estimates, by approximately 1.2 percentage points. (The standard error on the estimated difference of 1.2 percentage points is about 0.8.) For non-Black Hispanics and others, however, the direction of difference is the same as the total population: set 5 estimates exceed set 3 by approximately 2.1 to 2.2 percentage points for Spanish (with a standard error of approximately 1.2 to 1.3) and 0.9 for others (with a standard error of approximately 0.2). The shifts between set 5 and set 3 for non-Black Hispanics and for others are consequently not statistically significantly different from each other. The shift for Blacks differs by a statistically significant amount, however, from the shifts for either of the other two groups.

Differences between E-sample sets 8 and 9 were only 0.4 to 0.5 percentage points for the total population. For Blacks and for non-Black Hispanics, the effect is larger: 1.2 percentage points for the former group and 1.1 to 1.2 for the latter. (The differences for Blacks and for non-Black Hispanics are not significantly different from one another.) The difference for others is only 0.2 to 0.3 percentage points. Hence, the contrast between sets 8 and 9 is concentrated on the Black and non-Black Hispanic populations.

Differences between E-sample sets 9 and 20, however, are more evenly distributed among the three groups: 0.5 percentage points for Blacks, and 0.3 for both non-Black Hispanics and others. (Differences among groups are not statistically significantly different from each other.)

In summary, most comparisons show that the choice of methodology typically has an effect in the same direction for all three groups. Frequently, however, the magnitude of the effect varies by group. For two important comparisons: the choice of missing data procedures, represented by the comparison of sets 14 and 3; and the interpretation of E-sample data collected from the post office, represented by the comparison of sets 8 and 9, the effects

for Blacks and for non-Black Hispanics are approximately equal but much larger than for others. For the analysis of the effects of movers in the August CPS, non-Black Hispanics show distinctly larger effects than Blacks or others. Only for comparisons of two relatively inconsequential choices, between sets 2 and 3 in April and sets 9 and 20 for the E sample, do all three groups show approximately the same effect. In one comparison, set 3 for April to set 5 for August, the estimated effect from this sample was in an opposite direction for Blacks than for the other two groups. Because of sampling error, however, it is only possible to conclude that the effect of the comparison was different for Blacks, without determining that the direction of change was in opposite directions by statistically significant amounts.

Within any one of the twelve sets, estimates for both the Black and non-Black Hispanic groups exceed those for others. Except for one instance, all contrasts between estimates for either Black or non-Black Hispanic and estimates for others are significant; in only one case is the difference only marginally significant: non-Black Hispanics for set 14-8. In this last case, the contrast between 0.0 percent undercount for non-Black Hispanics and a 1.3 percent overcount for others has a standard error of approximately 0.8 percent.

On account of sampling variability, the difference between the Black and non-Black Hispanic undercount rate is not statistically significant for any of these sets. (In a few instances, contrasts appear marginally significant, that is, with $.05 < p < .10$. Here p denotes the largest significance level of a hypothesis test that would reject the null hypothesis that the undercount rates were the same for the two groups.) Although the Black estimate exceeds the non-Black Hispanic estimate for all of the sets based on April data, the only contrast marginally significant at this level is based upon the 2-20 set. Two of the three August estimates, 5-8 and 5-9, show non-Black Hispanics to have greater undercounts than Blacks by marginally significant amounts.

Although the twelve sets of estimates consistently show a greater undercount for Blacks and non-Black Hispanics than for others, the magnitude of the estimated differential depends critically on the choice of set. For sets based upon 14, the estimated differentials range from 1.3 to 3.6

percentage points. The range for the estimated differentials for the remaining nine sets is from 3.2 to 7.2.

7.C. ESTIMATES FOR STATES

Tables 7.3, 7.4, and 7.5 display twelve sets of dual-system estimates of census undercount for States. The estimates have been grouped in order to show the effect of the choice of P-sample or E-sample set of estimates upon the resulting dual-system estimates.

Table 7.3 presents five sets of estimates based on different P samples but the same E-sample set, set 8, which is the only one combined with all of the five P-sample sets. Two columns of estimated standard errors are shown, one for April and one for August estimates. Although standard errors had been computed for each individual set, the outcomes were so similar for any of the sets based upon April data that the single standard error shown serves as an adequate summary. Similarly, the standard errors for August shown in table 7.3 may be used for any August set in tables 7.3, 7.4, or 7.5.

The first three sets of estimates in table 7.3 are ordered by increasing size for the corresponding national estimates. Differences between 14-8 and 3-8 are quite large and vary by State. Most differences fall in the range of 1.0 to 3.0 percentage points, although a few States appear on either side of this interval. Thus, the two sets of estimates portray substantially dissimilar pictures of the relative undercount of the various States compared to each other. There is some suggestion of a geographic pattern to the differential, particularly for the West North Central division, where differences between 14-8 and 3-8 are comparatively small.

As a technical note, two sources of variance affect comparisons between sets 14-8 and 3-8 in table 7.3. Since both estimates are based on the same sample households, the estimated standard errors for each set alone do not provide a useful representation of the standard error of the comparison, because there is a high covariance between the two sets. Nonetheless, the comparisons are affected by sampling variability. In addition, since set

3 employs an imputation procedure, estimates based upon set 3 include a component of variance, imputation variance,¹ often not represented by standard design-based variance estimators, including the replication procedure employed for PEP. For example, the percentage point difference for Maine is 1.3, while that for New Hampshire is only 0.8. It is probably unsafe to conclude that the difference of 0.5 between the two States would have consistently arisen over hypothetical repetitions of the PEP sampling and imputation; in fact, it is more probable that over repetitions of the PEP sample design and imputation procedure, the difference for New Hampshire would often exceed that for Maine. Thus, table 7.3 shows the combined effect of random and systematic differences due to choice of estimation procedure on the estimated relationship among States.

Differences at the state level between 3-8 and 2-8 are far less important. The largest difference is only 0.6 percentage points; the majority of States differ by 0.1 percentage point or less.

Differences between 10-8 and 5-8 are almost as large and varied as those between 14-8 and 3-8. The difference for the majority of States falls in the interval from 0.5 to 1.5 percentage points, but in many cases the difference is considerably more than 1.5 and in a few cases is less than 0.5. A difference of 3.7 percentage points occurs for Nevada, and several States have differences greater than 2.0. Thus, the choice of estimation procedure also has a large effect on the estimated State standings given by 10-8 and 5-8. Again, however, it should be recognized that some of variation among States in the observed difference is due to random variation rather than systematic error.

Differences between sets of estimates across the two months are more substantially affected by sampling error. Even though differences across months are large, much

of this variation must be viewed as the result of sampling variability. For example, differences between sets 3-8 and 5-8, after adjustment for the national difference of .7 percentage points between the two sets, appear almost to vary within the given sampling errors. Some systematic differences are suggested, however; in particular the difference between 3-8 and 5-8 seems pronounced in the West, especially in the Mountain States. Choice between the two sets of estimates makes a large difference in the relationship among States, but little of this effect appears to be definitely systematic.

Tables 7.4 and 7.5 show the effect of varying the choice of E-sample set for a fixed P sample. It is clear from these tables that the selection of E-sample set also makes a difference in the overall level of the estimates and the relationship among States. For the most part, however, differences represented by variation among the E-sample sets are far less important than P-sample variation. Two exceptions are notable, however: the range of estimates over different choices of E sample for the District of Columbia is approximately 3.1 percentage points, and that for Nevada is approximately 2.7 percentage points. All remaining ranges are less than 1.5 percentage points wide.

7.D. ESTIMATES FOR REGIONS

Table 7.6 presents estimates for the four census regions. The estimates are consistent with the State estimates in tables 7.3, 7.4, and 7.5.

The effect of the choice of P-sample and E-sample set to form the dual-system estimate closely parallels the patterns for States. The choice between 14-8 and 3-8 has a substantial effect on the level of estimated undercount and makes an appreciable impact on the differentials among regions. The differences are 1.7, 1.5, 2.2, and 2.4 percentage points for the Northeast, Midwest, South, and West, respectively. Because of the high covariances between the two estimates for one region, it is clear that the differences for the Northeast and Midwest regions differ systematically from the differences for the South and West.

Differences between 3-8 and 2-8 are unimportant at a regional level, amounting to only 0.1 or 0.2 percentage points. This

comparative unimportance of the difference between set 3-8 and set 2-8 follows the pattern for the State estimates.

Differences between 10-8 and 5-8 again suggest a contrast between the effect on the Northeast and Midwest regions compared to the South and West. The differences for the Northeast and Midwest regions are 1.2 and 0.9 percentage points; those for the South and West are 1.7 and 1.8 percentage points. Again, this contrast is presumably statistically significant because of the high covariances between the 10-8 and 5-8 estimates.

Comparisons between April and August sets are affected by a considerably higher level of sampling error because two different P samples are involved. Set 14-8 differs from set 5-8 in the estimated geographic differential in the undercount: 5-8 exceeds 14-8 by 2.0 and 1.7 percentage points in the Northeast and Midwest regions, respectively, and by 3.5 and 3.4 percentage points in the South and West, so that the differences for the first two regions differ significantly from the second two. For all other comparisons between April and August estimates, the differentials by region do not appear clearly significantly different from each other.

The choice of E-sample set has relatively small effect on the estimated geographic distribution of the undercount by region.

In summary, the relative standing of the regions with respect to estimated undercount varies according to the choice of P-sample, and to a lesser extent, E-sample set. Nonetheless, the twelve sets of estimates show the West to be disproportionately undercounted.

7.E. ESTIMATES FOR CITIES

Tables 7.7, 7.8, and 7.9 display twelve sets of dual-system estimates of census undercount for sixteen cities, each of which was a central city of a Standard Metropolitan Statistical Area in 1980. The estimates for Washington, DC, from tables 7.3, 7.4, and 7.5 reappear in the tables for cities. As before, the estimates have been grouped in order to show the effect of the choice of P-sample or E-sample set of estimates upon the resulting dual-system estimates. The two sets of standard errors shown in table 7.7 may serve for any April

¹Donald B. Rubin, "Multiple Imputations in Sample Surveys — A Phenomenological Bayesian Approach to Nonresponse," *Proceedings of the Section on Survey Research Methods*, American Statistical Association: Washington, DC; 1978, pp. 20-34; Donald B. Rubin, and Nathaniel Schenker, "Multiple Imputation for Interval Estimation From Simple Random Samples With Ignorable Nonresponse," *Journal of the American Statistical Association*, Vol. 81 (June 1986), pp. 366-374; and Donald B. Rubin, *Multiple Imputation for Survey Nonresponse*, John Wiley: New York, 1986.

or August set, respectively. For analytic purposes, a column showing percent minority (Black or Hispanic) has been added to each table.

As with the State estimates, differences between 14-8 and 3-8 in table 7.7 are dramatic. The range for differences between sets is even larger for cities than for states, from 1.0 to 8.1 percentage points. All but three of the cities fall in the range for differences from 1.0 to 5.0 percentage points.

Both set 14-8 and set 3-8 show a wide range of outcomes for this group of cities. For set 3-8, however, the subset of eleven cities with 40 percent minority or more appear similar, in view of the relatively high standard errors.

Differences between 3-8 and 2-8 are somewhat more pronounced than for States, yet these differences are still relatively less important than other differences shown in table 7.7. The largest percentage point difference is 1.2.

For States, differences between 10-8 and 5-8 in table 7.3 are almost as large and variable as differences between 14-8 and 3-8. For cities, the range of differences between 10-8 and 5-8 is from 0.6 to 3.4 percentage points. Ten differences fall in the interval from 1.0 to 2.0 percentage points, and all but two cities are in the interval from 1.0 to 3.0 percentage points. Thus, differences between 10-8 and 5-8 are also important for cities, but not quite to the degree as the choice between 14-8 and 3-8.

Estimates from 5-8, and to a lesser extent, from 10-8, show approximately the same consistency for cities with over 40 percent minority population as for 2-8 and 3-8. The estimate for Washington, DC, stands as an exception, but the effect of sampling variation could account for this departure from the general pattern.

Comparisons of April with August sets are so influenced by random variability that it is difficult to discern systematic

patterns. Some pairings of April and August estimates, for example, 2-8 or 3-8 with 5-8, appear to be within sampling error, but the sampling errors effectively obscure the detection of systematic error across the two P-sample months.

Table 7.8 presents comparisons of dual-system estimates for cities by varying the choice of E-sample set. Differences between sets 14-8 and 14-9, or between 14-9 and 14-20, are larger than the corresponding differences for States in table 7.4. The range of estimates over choices of E-sample methodology varies from 0.0 percentage points wide, for Milwaukee, to 3.6 percentage points wide, for Boston. Differences from 14-8 to 14-9 or differences from 14-9 to 14-20 are each substantial in specific cities. Table 7.9 presents additional estimates consistent with the patterns indicated by table 7.8.

Table 7.1. Dual-System Estimates of Percent Undercount for the Noninstitutional Population, by Race and Ethnicity, Ordered by the Estimated Total Undercount

Set of dual-system estimates	Total	Black	Non-Black Hispanic	Others
14-8.....	-1.0	1.1	0.0	-1.3
14-9.....	-0.5	2.3	1.2	-1.1
14-20.....	-0.2	2.8	1.5	-0.8
10-8.....	0.3	2.8	3.7	-0.4
3-8.....	1.0	5.7	4.5	0.0
2-8.....	1.1	6.1	4.7	0.0
3-9.....	1.4	6.9	5.6	0.2
2-9.....	1.5	7.3	5.8	0.3
5-8.....	1.7	4.5	6.6	0.9
3-20.....	1.7	7.4	5.9	0.5
2-20.....	1.9	7.8	6.1	0.6
5-9.....	2.1	5.7	7.8	1.2
Approx. s.e. (sets 2, 3, 14)2	.6	.8	.2
Approx. s.e. (sets 5,10)2	.6	1.0	.2

Table 7.2. Dual-System Estimates of Percent Undercount for the Noninstitutional Population, by Race and Ethnicity, Arranged to Show the Effects of Methodological Differences

Race/ethnicity	Comparisons of the April P sample					
	2-8	3-8	14-8	2-9	3-9	14-9
Total.....	1.1	1.0	-1.0		1.5	1.4
Black.....	6.1	5.7	1.1		7.3	6.9
Non-Black Hispanic.....	4.7	4.5	0.0		5.8	5.6
Other.....	0.0	0.0	-1.3		0.3	0.2
	2-20	3-20	14-20			
Total.....	1.9	1.7	-0.2			
Black.....	7.8	7.4	2.8			
Non-Black Hispanic.....	6.1	5.9	1.5			
Other.....	0.6	0.5	-0.8			
Comparisons of the August P sample						
	5-8	10-8				
Total.....	1.7	0.3				
Black.....	4.5	2.8				
Non-Black Hispanic.....	6.6	3.7				
Other.....	0.9	-0.4				
Comparisons of the E sample						
	2-8	2-9	2-20	3-8	3-9	3-20
Total.....	1.1	1.5	1.9	1.0	1.4	1.7
Black.....	6.1	7.3	7.8	5.7	6.9	7.4
Non-Black Hispanic.....	4.7	5.8	6.1	4.5	5.6	5.9
Other.....	0.0	0.3	0.6	0.0	0.2	0.5
	5-8	5-9		14-8	14-9	14-20
Total.....	1.7	2.1		-1.0	-0.5	0.3
Black.....	4.5	5.7		1.1	2.3	2.8
Non-Black Hispanic.....	6.6	7.8		0.0	1.2	3.7
Other.....	0.9	1.2		-1.3	-1.1	-0.4

Table 7.3. Dual-System Estimates of Percent Undercount for the Noninstitutional Population, by State, Selected to Show the Effect of Choice of P-Sample Set

State	Set of dual-system estimates							
	14-8	3-8	2-8	s.e.	10-8	5-8	s.e.	
Northeast								
New England								
Maine	0.7	2.0	2.0	0.9	1.1	1.9	0.8	
New Hampshire	-2.4	-1.6	-1.7	1.2	-0.9	1.1	1.3	
Vermont	-1.5	-1.1	-1.0	0.6	-1.6	-0.2	0.8	
Massachusetts	-2.4	-1.2	-1.2	0.7	-1.4	-0.6	0.9	
Rhode Island	-0.9	0.9	0.8	0.9	-0.9	1.2	0.9	
Connecticut	-2.2	-1.2	-0.6	1.4	-1.5	0.4	1.2	
Middle Atlantic								
New York	-1.1	1.6	1.8	0.6	0.4	1.7	0.7	
New Jersey	-0.3	1.3	1.4	0.9	0.0	1.4	0.9	
Pennsylvania	-1.3	-0.3	0.1	0.6	-1.3	-0.3	0.7	
Midwest								
East North Central								
Ohio	-0.5	1.1	1.1	0.6	0.0	1.0	0.5	
Indiana	-2.0	-0.6	-0.6	0.8	1.5	2.4	0.9	
Illinois	-0.9	2.1	2.0	0.6	0.0	1.1	0.7	
Michigan	-0.5	0.8	1.0	0.6	-0.1	1.2	0.4	
Wisconsin	0.7	1.7	1.7	0.6	0.0	0.4	0.4	
West North Central								
Minnesota	0.2	1.1	1.2	0.6	0.5	1.1	0.4	
Iowa	-1.3	-0.7	-0.6	1.1	-0.3	0.7	0.8	
Missouri	-0.1	0.8	1.0	0.7	-0.5	0.6	0.7	
North Dakota	-0.7	0.0	0.1	0.3	0.3	0.6	0.6	
South Dakota	-0.6	0.1	0.3	0.6	0.9	2.2	1.1	
Nebraska	-0.7	0.1	0.2	0.5	0.5	1.4	1.0	
Kansas	-0.8	0.6	0.8	1.0	-0.9	1.9	0.9	
South								
South Atlantic								
Delaware	-1.9	-0.6	-0.4	1.0	0.2	1.0	1.2	
Maryland	0.9	2.4	2.6	1.3	1.7	2.8	0.8	
District of Columbia	1.4	3.6	4.0	1.6	-0.8	0.5	2.2	
Virginia	-0.9	0.1	0.7	0.9	0.8	1.7	0.7	
West Virginia	-1.9	-0.6	-0.7	1.3	-2.2	-1.0	1.3	
North Carolina	-0.3	1.2	1.1	1.2	1.2	2.1	1.2	
South Carolina	3.5	5.9	5.8	2.6	2.2	4.1	2.8	
Georgia	-2.2	-0.5	-0.1	0.7	-1.0	1.3	0.8	
Florida	-1.0	1.4	1.6	0.8	1.3	4.2	1.4	
East South Central								
Kentucky	-2.6	-1.6	-1.4	1.0	-0.7	0.2	1.1	
Tennessee	-4.2	-2.9	-2.9	1.3	-3.3	-2.4	1.6	
Alabama	-2.3	-0.4	-0.4	0.9	-1.3	-0.4	0.9	
Mississippi	-0.9	1.0	1.0	1.3	1.0	2.9	1.6	
West South Central								
Arkansas	-2.4	-1.1	-1.0	1.3	0.0	1.4	1.6	
Louisiana	-0.5	2.3	2.2	2.2	0.2	1.9	2.2	
Oklahoma	-2.6	-0.2	-0.1	1.0	-0.6	0.9	1.4	
Texas	-3.2	0.4	0.6	0.9	0.3	2.9	1.1	
West								
Mountain								
Montana	-0.2	1.4	1.5	1.0	2.1	2.4	1.0	
Idaho	0.2	1.2	1.4	0.8	2.8	4.5	1.0	
Wyoming	1.6	3.5	3.6	1.2	2.2	4.5	1.3	
Colorado	-1.8	0.3	0.7	1.0	1.5	3.6	1.1	
New Mexico	-1.1	2.3	2.4	1.0	2.4	3.8	1.3	
Arizona	-0.1	2.0	1.7	1.4	2.6	4.9	1.2	
Utah	-0.2	0.4	0.5	0.8	0.3	1.9	0.7	
Nevada	-0.3	2.6	2.9	1.3	0.9	4.8	1.7	
Pacific								
Washington	-0.6	1.4	1.5	0.9	1.6	3.4	1.3	
Oregon	-1.3	0.3	0.4	0.8	0.8	2.1	0.9	
California	0.3	3.0	3.3	0.6	1.2	2.8	0.5	
Alaska	1.2	2.8	2.9	1.2	4.5	7.4	2.6	
Hawaii	-0.8	1.1	1.3	1.2	1.3	2.2	1.0	

Table 7.4 Additional Dual-System Estimates of Percent Undercount for the Noninstitutional Population, by State, Showing the Effect of E-Sample Set

State	Set of dual-system estimates					
	14-8	14-9	14-20	3-8	3-9	3-20
Northeast						
New England						
Maine	0.7	0.7	1.0	2.0	2.0	2.2
New Hampshire	-2.4	-2.2	-1.8	-1.6	-1.4	-1.0
Vermont	-1.5	-1.6	-0.9	-1.1	-1.3	-0.6
Massachusetts	-2.4	-1.5	-1.2	-1.2	-0.3	0.0
Rhode Island	-0.9	-1.0	-0.6	0.9	0.8	1.2
Connecticut	-2.2	-1.8	-1.3	-1.2	-0.8	-0.3
Middle Atlantic						
New York	-1.1	-0.6	-0.4	1.6	2.1	2.4
New Jersey	-0.3	-0.3	0.0	1.3	1.3	1.7
Pennsylvania	-1.3	-1.0	-0.8	-0.3	0.0	0.2
Midwest						
East North Central						
Ohio	-0.5	-0.4	-0.2	1.1	1.2	1.4
Indiana	-2.0	-1.9	-1.7	-0.6	-0.6	-0.4
Illinois	-0.9	-0.2	0.0	2.1	2.8	2.9
Michigan	-0.5	-0.1	0.1	0.8	1.2	1.4
Wisconsin	0.7	0.7	0.8	1.7	1.7	1.7
West North Central						
Minnesota	0.2	0.6	0.7	1.1	1.5	1.6
Iowa	-1.3	-1.3	-1.3	-0.7	-0.7	-0.6
Missouri	-0.1	0.0	0.2	0.8	0.9	1.1
North Dakota	-0.7	-0.4	-0.4	0.0	0.3	0.4
South Dakota	-0.6	-0.5	-0.4	0.1	0.2	0.3
Nebraska	-0.7	-0.5	-0.3	0.1	0.3	0.5
Kansas	-0.8	-0.7	-0.3	0.6	0.7	1.1
South						
South Atlantic						
Delaware	-1.9	-1.6	-1.2	-0.6	-0.4	0.0
Maryland	0.9	1.1	1.4	2.4	2.6	2.9
District of Columbia	1.4	3.4	4.5	3.6	5.6	6.7
Virginia	-0.9	-0.5	-0.3	0.1	0.5	0.7
West Virginia	-1.9	-2.0	-1.6	-0.6	-0.6	-0.3
North Carolina	-0.3	-0.1	0.3	1.2	1.4	1.8
South Carolina	3.5	3.8	4.9	5.9	6.3	7.3
Georgia	-2.2	-1.8	-1.4	-0.5	0.0	0.3
Florida	-1.0	-0.4	0.0	1.4	2.0	2.4
East South Central						
Kentucky	-2.6	-2.6	-2.1	-1.6	-1.6	-1.0
Tennessee	-4.2	-3.6	-3.6	-2.9	-2.3	-2.4
Alabama	-2.3	-2.0	-1.3	-0.4	0.0	0.6
Mississippi	-0.9	-0.4	-0.2	1.0	1.5	1.7
West South Central						
Arkansas	-2.4	-2.1	-1.4	-1.1	-0.8	-0.1
Louisiana	-0.5	-0.3	0.5	2.3	2.6	3.3
Oklahoma	-2.6	-2.6	-2.2	-0.2	-0.2	0.2
Texas	-3.2	-2.4	-1.9	0.4	1.2	1.7
West						
Mountain						
Montana	-0.2	0.1	0.5	1.4	1.7	2.1
Idaho	0.2	0.3	0.6	1.2	1.4	1.7
Wyoming	1.6	2.0	2.1	3.5	3.9	3.9
Colorado	-1.8	-1.1	-0.8	0.3	1.0	1.3
New Mexico	-1.1	-0.8	-0.5	2.3	2.6	2.9
Arizona	-0.1	0.7	1.2	2.0	2.8	3.3
Utah	-0.2	0.5	0.6	0.4	1.1	1.2
Nevada	-0.3	1.9	2.5	2.6	4.8	5.3
Pacific						
Washington	-0.6	-0.7	-0.1	1.4	1.3	1.9
Oregon	-1.3	-0.9	-0.5	0.3	0.8	1.2
California	0.3	1.0	1.4	3.0	3.8	4.1
Alaska	1.2	1.7	1.9	2.8	3.2	3.4
Hawaii	-0.8	-0.6	0.0	1.1	1.3	1.9

Table 7.5. Additional Dual-System Estimates of Percent Undercount for the Noninstitutional Population, by State, Showing the Effect of E-Sample Set

State	Set of dual-system estimates				
	2-8	2-9	2-20	5-8	5-9
Northeast					
New England					
Maine	2.0	2.1	2.3	1.9	1.9
New Hampshire	-1.7	-1.5	-1.0	1.1	1.3
Vermont	-1.0	-1.1	-0.4	-0.2	-0.4
Massachusetts	-1.2	-0.3	0.0	-0.6	0.3
Rhode Island.....	0.8	0.7	1.1	1.2	1.1
Connecticut	-0.6	-0.3	0.2	0.4	0.8
Middle Atlantic					
New York	1.8	2.3	2.5	1.7	2.1
New Jersey	1.4	1.4	1.8	1.4	1.4
Pennsylvania.....	0.1	0.3	0.5	-0.3	0.0
Midwest					
East North Central					
Ohio	1.1	1.2	1.4	1.0	1.2
Indiana	-0.6	-0.6	-0.4	2.4	2.4
Illinois	2.0	2.7	2.8	1.1	1.8
Michigan.....	1.0	1.3	1.6	1.2	1.5
Wisconsin	1.7	1.7	1.7	0.4	0.4
West North Central					
Minnesota	1.2	1.6	1.7	1.1	1.5
Iowa	-0.6	-0.6	-0.5	0.7	0.7
Missouri	1.0	1.1	1.3	0.6	0.7
North Dakota	0.1	0.3	0.4	0.6	0.9
South Dakota	0.3	0.4	0.5	2.2	2.3
Nebraska	0.2	0.4	0.6	1.4	1.6
Kansas	0.8	0.9	1.3	1.9	2.0
South					
South Atlantic					
Delaware	-0.4	-0.2	0.2	1.0	1.3
Maryland	2.6	2.8	3.1	2.8	3.0
District of Columbia	4.0	5.9	7.1	0.5	2.5
Virginia.....	0.7	1.1	1.3	1.7	2.1
West Virginia	-0.7	-0.7	-0.4	-1.0	-1.0
North Carolina	1.1	1.4	1.7	2.1	2.3
South Carolina	5.8	6.2	7.2	4.1	4.4
Georgia.....	-0.1	0.4	0.7	1.3	1.8
Florida.....	1.6	2.2	2.6	4.2	4.7
East South Central					
Kentucky	-1.4	-1.4	-0.8	0.2	0.2
Tennessee	-2.9	-2.3	-2.4	-2.4	-1.8
Alabama	-0.4	0.0	0.6	-0.4	0.0
Mississippi	1.0	1.5	1.7	2.9	3.5
West South Central					
Arkansas	-1.0	-0.7	-0.1	1.4	1.7
Louisiana	2.2	2.5	3.2	1.9	2.1
Oklahoma	-0.1	-0.1	0.3	0.9	0.9
Texas	0.6	1.5	2.0	2.9	3.7
West					
Mountain					
Montana	1.5	1.8	2.2	2.4	2.7
Idaho	1.4	1.5	1.8	4.5	4.6
Wyoming	3.6	4.0	4.0	4.5	4.9
Colorado	0.7	1.3	1.6	3.6	4.2
New Mexico.....	2.4	2.7	3.0	3.8	4.0
Arizona	1.7	2.5	3.0	4.9	5.6
Utah	0.5	1.1	1.2	1.9	2.6
Nevada	2.9	5.1	5.6	4.8	6.8
Pacific					
Washington	1.5	1.5	2.0	3.4	3.4
Oregon	0.4	0.9	1.3	2.1	2.6
California	3.3	4.0	4.4	2.8	3.6
Alaska	2.9	3.4	3.5	7.4	7.8
Hawaii	1.3	1.5	2.1	2.2	2.4

Table 7.6. Dual-System Estimates of Percent Undercount for the Noninstitutional Population, by Region

Region	Set of dual-system estimates						
	14-8	3-8	2-8	s.e.	10-8	5-8	s.e.
Northeast.....	-1.2	0.5	0.7	0.3	-0.4	0.8	0.4
Midwest.....	-0.6	0.9	1.0	0.2	0.2	1.1	0.2
South.....	-1.6	0.6	0.7	0.3	0.2	1.9	0.4
West.....	-0.2	2.2	2.4	0.4	1.4	3.2	0.4
	14-8	14-9	14-20		3-8	3-9	3-20
Northeast.....	-1.2	-0.9	-0.6		0.5	0.9	1.2
Midwest.....	-0.6	-0.3	-0.1		0.9	1.2	1.4
South.....	-1.6	-1.1	-0.7		0.6	1.0	1.5
West.....	-0.2	0.5	0.9		2.2	2.9	3.2
	2-8	2-9	2-20		5-8	5-9	
Northeast.....	0.7	1.1	1.4		0.8	1.2	
Midwest.....	1.0	1.3	1.4		1.1	1.4	
South.....	0.7	1.2	1.6		1.9	2.4	
West.....	2.4	3.1	3.4		3.2	3.8	

Table 7.7. Dual-System Estimates of Percent Undercount for the Noninstitutional Population, for Sixteen Cities, Selected to Show the Effect of Choice of P-Sample Set

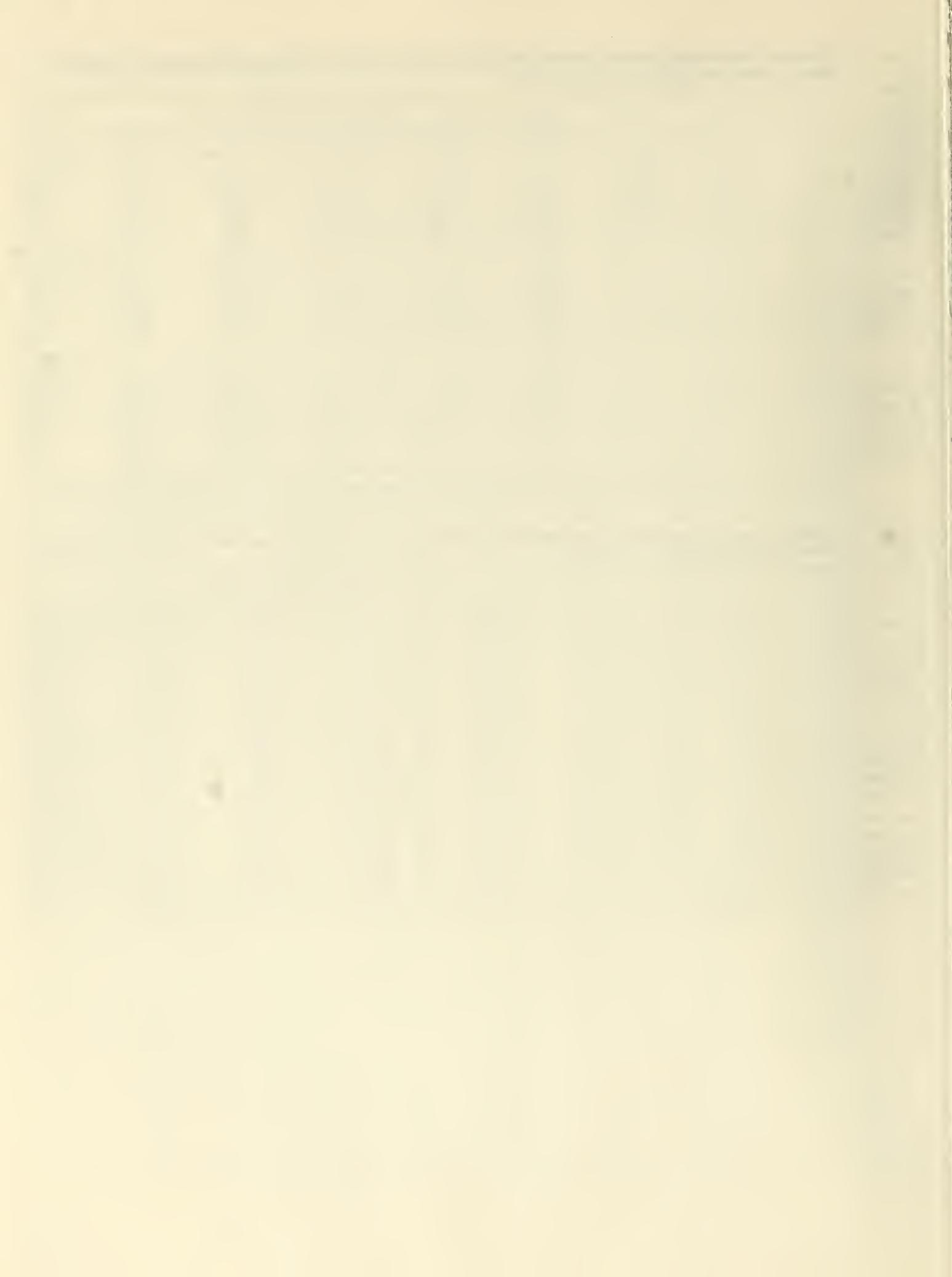
City	Set of dual-system estimates							Percent minority
	14-8	3-8	2-8	s.e.	10-8	5-8	s.e.	
Baltimore.....	3.2	5.4	5.8	1.7	2.7	4.6	1.7	56
Boston.....	-5.3	-1.0	-0.8	4.1	0.4	1.4	7.2	28
Chicago.....	-1.6	4.4	3.6	1.5	2.1	3.8	1.8	54
Cleveland.....	1.7	4.9	4.7	2.2	5.3	7.2	2.5	47
Dallas.....	-1.6	5.9	7.0	2.0	3.3	4.7	1.8	42
Detroit.....	0.4	3.1	3.3	2.3	0.7	3.6	1.8	65
Houston.....	-3.5	4.6	4.8	2.6	5.5	8.1	2.8	45
Indianapolis.....	-2.5	-0.2	0.3	2.1	3.2	5.8	2.7	22
Los Angeles.....	0.8	4.6	5.3	1.4	1.9	3.3	1.2	44
Milwaukee.....	1.2	3.1	3.2	1.4	1.3	2.0	1.4	27
New York.....	0.8	6.0	6.4	1.2	2.0	3.2	1.0	44
Philadelphia.....	1.5	4.7	5.9	1.9	1.5	2.8	1.5	41
St. Louis.....	0.3	3.1	3.1	2.1	1.3	4.7	2.8	47
San Diego.....	-2.0	-1.0	-1.0	2.3	-0.6	0.0	2.4	24
San Francisco.....	0.0	4.6	4.3	2.9	-0.5	2.3	1.9	25
Washington, DC.....	1.4	3.6	4.0	1.6	-0.8	0.5	2.2	73

Table 7.8. Additional Dual-System Estimates of Percent Undercount for the Noninstitutional Population, for Sixteen Cities, Showing the Effect of E-Sample Set

City	Set of dual-system estimates					
	14-8	14-9	14-20	3-8	3-9	3-20
Baltimore.....	3.2	3.5	4.3	5.4	5.7	6.5
Boston.....	-5.3	-2.0	-1.7	-1.0	2.1	2.4
Chicago.....	-1.6	0.3	0.7	4.4	6.2	6.6
Cleveland.....	1.7	2.0	1.9	4.9	5.2	5.2
Dallas.....	-1.6	-0.3	0.0	5.9	7.1	7.5
 Detroit.....	0.4	1.5	2.2	3.1	4.1	4.8
Houston.....	-3.5	-2.3	-1.5	4.6	5.6	6.4
Indianapolis.....	-2.5	-2.5	-2.4	-0.2	-0.2	-0.1
Los Angeles.....	0.8	3.0	3.2	4.6	6.8	7.0
Milwaukee.....	1.2	1.2	1.2	3.1	3.1	3.2
 New York.....	0.8	1.8	2.3	6.0	7.0	7.5
Philadelphia.....	1.5	2.0	2.3	4.7	5.2	5.5
St. Louis.....	0.3	0.8	2.1	3.1	3.6	4.9
San Diego.....	-2.0	-0.5	0.4	-1.0	0.5	1.4
San Francisco.....	0.0	0.9	1.7	4.6	5.5	6.3
Washington, DC.....	1.4	3.4	4.5	3.6	5.6	6.7

Table 7.9. Additional Dual-System Estimates of the Percent Undercount for the Noninstitutional Population, for Sixteen Cities, Showing the Effect of E Sample

City	Set of dual-system estimates					
	2-8	2-9	2-20	5-8	5-9	
Baltimore.....	5.8	6.1	6.9	4.6	4.9	
Boston.....	-0.8	2.3	2.5	1.4	4.7	
Chicago.....	3.6	5.4	5.8	3.8	5.7	
Cleveland.....	4.7	5.0	5.0	7.2	7.5	
Dallas.....	7.0	8.2	8.5	4.7	6.0	
 Detroit.....	3.3	4.3	5.0	3.6	4.6	
Houston.....	4.8	5.8	6.6	8.1	9.1	
Indianapolis.....	0.3	0.3	0.4	5.8	5.8	
Los Angeles.....	5.3	7.5	7.7	3.3	5.5	
Milwaukee.....	3.2	3.2	3.2	2.0	2.0	
 New York.....	6.4	7.4	7.9	3.2	4.2	
Philadelphia.....	5.9	6.4	6.7	2.8	3.4	
St. Louis.....	3.1	3.6	4.9	4.7	5.2	
San Diego.....	-1.0	0.5	1.4	0.0	1.5	
San Francisco.....	4.3	5.2	5.9	2.3	3.2	
Washington, DC.....	4.0	5.9	7.1	0.5	2.5	



Chapter 8.—Comparison of 1980 Coverage Estimates Based on the Post-Enumeration Program and Demographic Analysis

In the previous chapters of this report, we have presented estimates of the coverage of the population in the 1980 census based on two different estimation methods—demographic analysis and the Post-Enumeration Program (PEP) match study. In this chapter, the demographic and PEP coverage estimates are compared to assess the degree of agreement between the two sets of estimates. Specifically, the demographic and PEP coverage estimates are evaluated with respect to three criteria:

1. Agreement in overall levels of coverage of the total population and for race and sex categories;
2. Conformity of age patterns of coverage for sex and race groups;
3. Conformity of sex ratios from the PEP and from estimates based on demographic analysis.

The comparative analysis of the PEP and demographic coverage estimates focuses mainly on national estimates. Since estimates of coverage for states in 1980 based on demographic analysis are not available, a detailed comparison of PEP and demographic estimates for subnational areas cannot be conducted. Instead, evaluation of estimates for subnational areas involves examination of the error of closure and change in coverage for regions between the 1970 and 1980 census implied by demographic indicators and 1980 PEP coverage estimates.

8.A. ALTERNATIVE 1980 COVERAGE ESTIMATES SELECTED FOR EVALUATION

8.A.1. PEP Estimates

A large number of alternative estimates of the coverage of population in the 1980 census (29) were generated in the PEP study, reflecting the range and uncertainty

of the underlying assumptions that had to be made to produce the estimates. As noted in previous chapters, consideration is generally limited to 12 alternative sets of estimates: 2-8, 2-9, 3-8, 3-9, 5-8, 5-9, 10-8, 2-20, 3-20, 14-8, 14-9, and 14-20. These 12 estimates had been used since the PEP results first became available in 1982, without favoring any one set over another. As described in chapter 7, several of the set pairings are very similar, in particular the set 2 and set 3 estimates (reflecting different treatment of missing data in the April sample) and the set 8, set 9, and set 20 estimates (reflecting different treatment of missing data in the E sample).

For the evaluation carried out in this chapter, an initial assessment of the agreement of the 1980 coverage estimates based on the PEP and demographic analysis is made by comparing the demographic estimates with all 12 of the alternative PEP estimates. The more detailed evaluation of the demographic and PEP estimates for race, sex, and age categories is based on comparisons of demographic estimates with 4 selected sets of PEP estimates: sets 3-8, 5-8, 10-8, and 14-8. The use of 4 sets rather than all 12 sets simplifies the analysis of the PEP and demographic coverage estimates for detailed age-sex-race groups. These 4 sets are representative of the range in the alternative PEP estimates; the selection of other sets would not lead to markedly different conclusions regarding comparison of the PEP and demographic coverage estimates. Detailed estimates for age-race-sex categories from all 12 sets of PEP estimates are displayed in appendix D.

8.A.2. Demographic Estimates

In contrast to the numerous sets of coverage estimates available from the PEP, this report presents a smaller number of alternative estimates of coverage based on demographic analysis. As described in chapter 2, the range in the demographic estimates reflects mainly uncertainty about

the size of the undocumented immigrant population in the country in 1980. The demographic estimates of coverage are also affected by other assumptions that must be made to prepare the estimates (e.g., assumptions about birth and death registration completeness, legal immigration, and emigration components).¹ However, reasonable variations in these other assumptions have considerably less effect on the range of coverage estimates than assumptions regarding the number of undocumented residents in 1980.

In the initial comparisons of estimated coverage levels of the PEP and demographic analysis, the PEP estimates are compared to 3 alternative sets of demographic estimates that incorporate different allowances for undocumented residents in 1980—specifically, those with 2.06 million, 3 million, and 4 million undocumented immigrants (designated as DA-1, DA-2, and DA-3, respectively, in the figures). Further detailed comparisons of the PEP estimates are based on the one set of demographic estimates that allow for 3 million undocumented residents.

The PEP estimates of coverage for detailed age, sex, and race groups refer to the noninstitutional population (corresponding to the presentation of PEP estimates in chapter 5), whereas the demographic estimates relate to the total resident population, including institutions. This difference in definition does not affect comparisons of the two estimates, however, since the institutional population generally represents only a very small fraction of the total population.

8.B. LEVELS OF COVERAGE

8.B.1. Total Population

As displayed in table 8.1 and figure 8.1, the 3 demographic estimates show net undercounts in the range of 1.0 to 1.8

¹See materials cited in appendix C, particularly the PERM memoranda, for detailed discussion of the assumptions underlying demographic analysis.

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percent. The 12 PEP estimates range much more widely from a net *overcount* of 1.0 percent to a net *undercount* of 2.1 percent. Only 6 of the 12 alternative PEP undercount estimates (2-8, 2-9, 3-8, 3-9, 5-8, 3-20) fall within the range defined by the alternative demographic estimates. Two of the remaining PEP sets (5-9, 2-20) show undercount rates that are slightly higher than all of the demographic estimates; the other 4 PEP sets (10-8, 14-8, 14-9, 14-20) give undercount rates (or even overcounts) that are significantly lower than the demographic estimates of percent net undercount.

With the exception of the PEP estimates based on sets 10- and 14-, figure 8.1 suggests a general similarity between the PEP and demographic analysis. The remaining 8 PEP estimates fall in a range of 1.0 to 2.1 percent undercount, with only 2 falling outside the range of the 3 demographic estimates. The next two sections show that this agreement for the total population is serendipitous. When the fine structure of the estimates (i.e., detailed coverage estimates by age group, sex, and race) is examined, considerably less similarity between the PEP and demographic estimates can be found.

8.B.2. Race and Sex Groups

The 12 alternative PEP estimates are compared with the demographic analysis estimates for race and sex groups in table 8.2 and figures 8.2 through 8.4. For the Black population, the 12 PEP estimates differ from the demographic analysis undercount estimate of 5.9 percent by an average of 1.8 percentage points. For White-and-other races, the PEP estimates differ from the demographic undercount estimate of 0.7 percent by an average 0.7 percentage points. Interestingly, the PEP 5-8 and 5-9 estimates, which overstate the undercount rate compared to the demographic estimates for White-and-other races, give lower estimates of undercount for Blacks compared to the demographic estimates. This pattern is reversed for the other 10 PEP sets of estimates.

Examination of sex-specific and sex-race-specific estimates shows that the similarity of some of the PEP and demographic estimates observed for the total population and racial groups is weakened further when the estimates are disaggregated by

sex. The major difference between the PEP and demographic coverage estimates for sex and sex-race groups is that in comparison to the corresponding demographic estimates, the PEP estimates tend to underestimate the undercount rates for males and overstate the undercount rates for females. As shown by the difference measures in table 8.2 and in figure 8.2, eight of the twelve PEP sets for total females exceed the estimated demographic undercount rate of 0.4 percent shown by DA-2. For males, all PEP sets except 5-9 are lower than the estimated demographic rate of 2.4 percent in DA-2.

Differences between the PEP and demographic estimates for sex groups are most conspicuous for Black males and Black females. (See figure 8.3.) The 12 PEP undercount estimates for Black males are 3.2 percentage points lower on average than the demographic undercount estimate of 8.8 percent, whereas the PEP estimates for black females average 2.0 points higher than the demographic undercount estimate of 3.1 percent. The average absolute differences for White-and-other-races males and females are considerably smaller than the differences for Blacks—1.1 and 0.7 percentage points, respectively. However, in comparison to the undercount rates for Whites-and-other races, these differences are relatively quite large. The tendency of each PEP set to overestimate the undercount rate of females and underestimate the rate of males relative to the demographic estimates is apparent for both race groups.

The foregoing analysis shows that the degree of agreement between the demographic analysis and PEP estimates for the total population or a racial group in any of the PEP sets is in large part a fortuitous circumstance. Agreement, when it does occur, comes about through large differences for both males and females, but by offsetting amounts. When the PEP estimate for females is higher than the demographic estimates, the estimate for males is too low (e.g., set 3-8 for Blacks). If the undercount estimate for females is close to the demographic estimate, the estimate for males is far lower (e.g., set 5-8 for Blacks; set 3-8 for White-and-other races; set 3-8 for total). Conversely, when the PEP estimate for males is close, the estimate for females is far higher than the demographic estimate (set 5-8 for White-and-other races; set 5-8 for total). None of

the PEP coverage estimates is close to the demographic estimates for both males and females.

8.C. CONFORMITY OF AGE PATTERNS OF COVERAGE

Detailed comparison of the PEP and demographic estimates for age-sex-race groups shows some broad similarities, among the various estimates, but also some major differences. For ease of comparison, detailed age-sex estimates for 4 PEP sets, 14-8, 10-8, 3-8, and 5-8, are shown in table 8.3 and figure 8.5 for Whites-and-other races and in table 8.4 and figure 8.6 for Blacks. These 4 sets give a representative picture of age patterns of coverage shown by the various PEP estimates. Detailed estimates for age-sex-race categories from all 12 sets of PEP estimates can be found in appendix D.

Examination of figures 8.5 and 8.6 shows that for most age groups that there is a considerable degree of consistency among the alternative PEP undercount rates in terms of approximate levels and broad age patterns. Furthermore, there is some consistency of the PEP estimates with the demographic estimates for selected age groups among females, especially White-and-other-races females. For males, however, there is little agreement in the age patterns of undercount from the PEP and demographic estimates, especially for Black males.

For White-and-other-races females, the age patterns and levels of the several PEP sets are very similar to the demographic estimates at ages 35 and over (except for the terminal age group, 75 and over). Substantial differences between the 3-8, 5-8, and 10-8 PEP estimates and the demographic analysis estimate occur only for ages 0-4, 15-19, and 20-24. In fact, the large differences in these specific age groups account for much of the overall excess in the PEP undercount estimates found for White-and-other-races females. PEP set 14-8 mirrors the DA-2 estimates in pattern but falls roughly one percentage point below the DA-2 estimates. (See difference measures in table 8.3.)

For Black females, there is general agreement at ages 25 to 64 between one or more sets of the PEP estimates and demographic analysis. (Note that the scale in figure 8.6 is much coarser than in figure

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8.5.) For ages 10 to 24 and 65 to 74, however, the PEP estimates are consistently higher than the demographic estimates. Again, PEP set 14-8 is an exception, falling generally below the other estimates.

For males (both Black and White-and-other races), there is general agreement among the alternative PEP estimates with regard to age patterns across all ages and with regard to level at ages 40 and over. The exception again is set 14-8 which is substantially lower than the others. There is, however, a significant divergence between the PEP and demographic analysis estimates at ages 35 to 64 for White-and-other-races males and at ages 25 to 64 for Black males; at each age, the demographic undercount estimate is substantially higher. For example, the difference between the demographic estimate and PEP estimate for Black males exceeds 10.0 percentage points at ages 40 to 54 for all 4 PEP sets (table 8.4). This difference can undoubtedly be attributed largely to some form of correlation bias leading to understatement of males in the PEP. The sex ratio analysis reported in the next section supports this interpretation. The understatement of males at ages 25 to 64 in the PEP mainly accounts for the overall shortfall of the PEP undercount rates of males in comparison to the demographic rates.

For White males, the age patterns of undercount in the PEP and demographic analysis are similar for ages 0-19 although the PEP level is higher (except set 14-8). At ages 20-24, though, the PEP data show substantially higher undercount levels, especially set 5-8. A possible explanation for the high PEP rates for Whites at ages 15-24 for females and 20-24 for males may be found in PEP treatment of group quarters (or CPS household definitions). It is precisely at these ages that the group quarters population is substantially larger than all other ages under age 65.

The evaluation of the consistency of age patterns of coverage rates carried out in this section demonstrates that, for many age-sex-race groups, the national PEP data and demographic analysis estimate give the same or similar indications of census coverage. In particular, for White-and-other-races females aged 5 to 14 and over 25 (i.e., all ages except 0-4 and 15-24) and for Black females aged 25 to 64, all of the results are roughly consistent. For males, especially Black males, differences between

the PEP and demographic analysis estimates can be extremely large and the PEP data appear deficient particularly in the age range 25 to 64.

8.D. CONFORMITY OF EXPECTED SEX RATIOS

Analysis of sex ratios of the population can be a very powerful tool. The relative size of male and female populations for a cohort can be specified within a very narrow range. The sex ratio of an age group is a function of three items: sex ratio at birth (an almost invariant demographic constant within racial groups), sex ratio of survival rates from birth (subject to little variability), and the sex ratio of immigrants. The latter generally has only a minor effect on the overall sex ratio unless the proportion of immigrants is very large and sex composition of the immigrants is markedly different from the general population. When an *expected* sex ratio can be specified, departures from the expected value are indicative of deficiencies in the data or of extraordinary conditions.

For the analysis in this section, the sex ratios of the demographic analysis estimates are taken as the standard "expected" sex ratios since they are not subject to potentially large errors. Table 8.5 and figures 8.7 and 8.8 compare the sex ratios from PEP estimates of the population for the two sets, 14-8 and 5-9, with expected sex ratios based on demographic analysis for the White-and-other-races population and the Black population. The age patterns of sex ratios in these two sets of PEP estimates are typical of the PEP estimates. The two sets selected do, however, represent the extremes shown in sex ratios for the total population. (Sex ratios for all 12 PEP sets, 3 demographic analysis estimates, and the 1980 census are shown in appendix E.) Also displayed in the figures and tables are sex ratios from the 1980 census counts.

For the Black population, the sex ratios from the PEP estimates fall far below the demographic estimates for ages 25 to 59. The differences exceed 8 percentage points for some ages. At these ages, the difference between the demographic and census sex ratios is most pronounced, yet the PEP estimates conform much more closely to the census, not the demographic estimates. Because of the robustness of sex

ratios from demographic analysis, this shortfall is indicative of serious misestimation of the relative undercounts of Black males and Black females in these ages (in large part attributable to the correlation bias noted earlier). Another anomaly in the PEP data can be found at ages under 10 in the PEP 14-8 estimates for Blacks. These sex ratios—less than 100 at ages 0-4 and over 104 at ages 5-9—deviate sharply from the demographic analysis sex ratios in age groups where the demographic ratios are least prone to error. In addition, the PEP ratios imply vastly different undercount rates for Black male children and Black female children—an unlikely occurrence.

For the White-and-other-races population, the close agreement between the census sex ratios and the PEP sex ratios is also apparent. The differences between the demographic sex ratios and those from the PEP are not as large as for Blacks. Only at ages 25-64 are any differences apparent. (See table 8.5.)

The lack of conformance of the PEP sex ratios with the demographic sex ratios and the similarity of the PEP ratios with census sex ratios show that the PEP was not successful at picking up coverage differences between males and females. Although some of the alternative PEP versions show large differences from demographic analysis for females, the measurement problems in the PEP appear to be especially severe for males, particularly Black males. Whatever factors make males hard to count in the census appear to be at work in the PEP also.

8.E. EVALUATION OF ALTERNATIVE ESTIMATES OF COVERAGE FOR REGIONS

The analysis in this chapter shows that several sets of PEP coverage estimates for the United States resident population in 1980 corroborate the demographic estimates in terms of broad levels of coverage, but the agreement of the two methods diminishes when the estimates are disaggregated into age, sex, and race categories. Since estimates of coverage for state populations in 1980 based on demographic analysis are not available, a similarly detailed evaluation of the correspondence of the PEP and demographic estimates for subnational areas has not been conducted. It is probable that the misestimation of coverage levels in the PEP observed

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nationally—overstating the coverage of males (especially ages 25 to 64) while understat-ing the coverage of females (especially ages 15 to 24)—affects the estimates of each state as well. What cannot be determined at the state level, in the absence of comparative demographic undercount esti-mates, is how completely the differences in estimates for males and females offset one another so that the estimates of the total population of states from the PEP and demographic analysis would agree in accu-rately representing coverage errors.

In this section, an indirect evaluation of the PEP estimates of coverage at the regional level will be carried out. Rather than making direct comparisons of PEP and demo-graphic estimates of coverage *levels* in 1980, the evaluation involves examining the *changes* in coverage between 1970 and 1980 for regions implied by the PEP estimates in comparison to errors of closure derived from demographic indicators. The evaluation reveals that the PEP esti-mates of coverage and demographic mea-sures show nearly identical patterns of regional variation in the change in cov-erage between 1970 and 1980, with cov-erage improvement being much greater in the South than in any other region.

8.E.1. Error of Closure for Regions: Improvement in Coverage for Regions Based on Demographic Indicators

Demographic estimates of coverage of the national population demonstrate that cov-erage in 1980 was substantially more com-plete than in 1970. (See chapter 3, section 3.B.2.) For example, the undercount of the legally resident population dropped from 2.6 percent in 1970 to only 1.0 percent in 1980; the undercount of the total resident population (including 3 million undocumented aliens in 1980) declined from 2.9 percent to 1.4 percent in 1980. As discussed previously in section 3.A of chapter 3, the relatively complete coverage of the 1980 census and the inclusion of undocumented aliens in the census counts resulted in a large error of closure of 5.15 million. That is, the population estimate for 1980 of 221,393,000 based on the 1970 census count fell 5.15 million short of the 1980 census count of 226,546,000. The error

of closure is reduced to 3.1 million if undoc-umented aliens counted in the 1980 cen-sus are excluded, but it is still large. Since esti-mates of population for 1980 based on the 1970 census and intercensal change are available for each state, the distribution of the 3.1 million error of closure at the regional level can be examined. To the extent that the intercensal population change between 1970 and 1980 for each region is estimated accurately, the error of closure figures can be interpreted as a demographic measure of the amount of coverage improve-ment in the 1980 census over the 1970 census for each region.

The shortfall of the 1980 estimate com-pared to the 1980 census figure was by far the greatest in the South, with the error of closure reaching 3.0 percent. (See table 8.6.) For all other regions, the error of closure was less than 1 percent. In terms of numbers of persons, the amount of error of closure in the South, 2.25 million persons, was almost 5 times the error of closure in the Midwest, the region with the next largest error of closure. The South accounted for about 73 percent of the national error of closure. Other research at the Bureau of the Census dealing with evalua-tion of the state population esti-mates for 1980 also identified the improved coverage levels in the South relative to other regions.²

8.E.2. Improvement in Coverage for Regions Based on PEP Results for 1980

The discussion of error of closure in the previous section treats only relative cov-erage levels in the censuses of 1980 and 1970. Direct evalua-tion of the PEP esti-mates for subnational areas in 1980 using measures similar to the error of closure requires esti-mates of census coverage the same geographic levels in 1970. Fortunately, the availability of PEP esti-mates of coverage for subnational areas in 1980 and developmental demographic esti-mates for regions and states in 1970 permit examination of geographic variations in improvement in coverage between 1970 and 1980.

²See *Current Population Reports*, Series P-25, No. 933, and *Current Population Reports*, Series P-25, No. 957

Table 8.7 compares undercount rates for regions in 1970 as estimated by demo-graphic analysis with esti-mates for 1980 from the 12 alternative PEP sets. The developmental demographic esti-mates for 1970 were based on a complex analysis of census data on state of birth for the popu-lation under 35 years of age, Medicare data for the population aged 65 and over, and indirect estimation methods for the population 35 to 64 years of age.³ Several sets of alternative esti-mates of coverage for states were prepared, none being deemed "preferred." Although the demographic esti-mates for several states showed a wide range among the various sets, a clear picture of coverage levels was displayed by the alternative sets at the regional level: undercount rates were highest in the South, lowest in the North, and generally intermediate in the West. The pattern of regional variations in coverage shown by the developmental demographic esti-mates for 1970 was roughly consistent with available results from match studies for 1970 and results from previous censuses of 1940-1960.⁴ To simplify the presentation in this evalua-tion, the demographic esti-mates for 1970 shown in table 8.6 represent an average of several alternative sets.⁵

Compared to the demographic esti-mates for 1970, the alternative PEP undercount rates for 1980 consistently reveal that the gains in coverage registered nationally between 1970 and 1980 occurred predom-inantly in the South. On average, the PEP undercount esti-mates for the South in 1980 represent a 3.4 percentage point improve-ment over the esti-mated undercount of 4.0 percent in 1970. (See difference mea-sures at bottom of table 8.6). The average improvement for the Northeast (1.1 per-centage points), Midwest (0.7 points), and West (1.2 points) were modest in compari-son. Overall, the relatively greater improve-ment in the South lowered the level of undercount in the region to the same low

³For a detailed description of the demo-graphic method for estimating the coverage of state populations in 1970, see *Current Population Reports*, Series P-23, No. 65, December 1977.

⁴See table I-2, p. 11 of *Current Population Reports*, Series P-23, No. 65

⁵The undercount esti-mates represent the average of the seven alterna-tive sets of esti-mates for each region shown in table VII-D, p. 99 of *Current Population Reports*, Series P-23, No. 65

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level characteristic of the North, in sharp contrast to the differential coverage levels observed in 1970. It is of significance to note that all PEP sets indicate that net undercount rates were highest in the West in 1980.

The regional pattern of coverage improvement for 1970 to 1980 shown by the

alternative PEP estimates in table 8.7 corresponds very closely to the pattern of errors of closure for regions in table 8.6. These two measures are virtually independent. Hence, the evidence of regional differences in improvement of coverage between 1970 and 1980 from demographic indicators corroborates the PEP results

which show net coverage gains in the South far surpassing any other regions.⁶

⁶The coverage gains represent gains in *net* undercount, i.e., the difference between gross omissions and gross overcounts. A gain could result from a reduction in gross omissions or an increase in gross duplications or some combination of both. See chapter 1.

Table 8.1. Undercount Rates from Demographic Analysis and Alternative PEP Estimates for the Total Population: 1980

(Base of percents is estimated population. See text for explanation of alternative estimates)

Estimate	Estimated percent undercount	Difference from alternative demographic estimate		
		Counted undocumented aliens ¹	3 million undocumented aliens	4 million undocumented aliens
Demographic analysis estimates				
Counted undocumented aliens ¹	1.0	(x)	(x)	(x)
3 million undocumented aliens	1.4	(x)	(x)	(x)
4 million undocumented aliens	1.8	(x)	(x)	(x)
PEP estimates				
2-8	1.1	0.1	-0.3	-0.7
2-9	1.5	0.6	-0.2	-0.3
3-8	1.0	-	-0.4	-0.8
3-9	1.4	0.4	-	-0.4
5-8	1.7	0.7	0.3	-0.1
5-9	2.1	1.2	0.7	0.3
10-8	0.3	-0.7	-1.1	-1.5
2-20	1.9	0.9	0.5	0.1
3-20	1.7	0.7	0.3	-0.1
14-8	-1.0	-1.9	-2.3	-2.8
14-9	-0.5	-1.5	-1.9	-2.3
14-20	-0.2	-1.2	-1.6	-2.0
Average absolute difference	(x)	0.8	0.8	0.9

- Represents zero or rounds to zero.

(x) Not applicable.

¹Includes an estimated 2.06 million undocumented aliens counted in the 1980 census.

Table 8.2 Undercount Rates from Demographic Analysis and Alternative PEP Estimates, by Race and Sex: 1980

(Base of percents is estimated population. See text for explanation of alternative estimates)

Estimate	Total population			Black			White-and-other races		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
Estimated percent undercount									
Demographic analysis estimate ¹ ...	1.4	2.4	0.4	5.9	8.8	3.1	0.7	-1.5	
PEP estimates									
2-8.....	1.1	1.3	0.9	6.1	6.8	5.5	0.4	0.6	0.3
2-9.....	1.5	1.8	1.3	7.2	8.1	6.4	0.8	1.0	0.5
3-8.....	1.0	1.2	0.8	5.7	6.3	5.3	0.3	0.5	0.2
3-9.....	1.4	1.6	1.1	6.8	7.4	6.2	0.6	0.8	0.4
5-8.....	1.7	2.1	1.3	4.5	5.4	3.8	1.3	1.7	1.0
5-9.....	2.1	2.6	1.7	5.7	6.7	4.7	1.7	2.1	1.3
10-8.....	0.3	0.5	0.1	2.8	3.2	2.5	-0.1	0.1	-0.3
2-20.....	1.9	2.2	1.6	7.8	8.8	6.9	1.0	1.3	0.8
3-20.....	1.7	2.0	1.4	7.4	8.2	6.7	0.9	1.2	0.7
14-8.....	-1.0	-1.0	-0.9	1.1	1.0	1.1	-1.2	-1.3	-1.2
14-9.....	-0.5	-0.5	-0.6	2.3	2.4	2.1	-0.9	-0.9	-1.0
14-20.....	-0.2	-0.1	-0.3	2.8	3.1	2.6	-0.6	-0.5	-0.7
Difference from demographic analysis estimate									
2-8.....	-0.2	-1.0	0.5	0.2	-2.0	2.3	-0.3	-0.9	0.2
2-9.....	0.2	-0.5	0.9	1.3	-0.6	3.3	-	-0.5	0.5
3-8.....	-0.4	-1.2	0.4	-0.2	-2.5	2.1	-0.4	-1.0	0.1
3-9.....	-	-0.7	0.7	0.9	-1.4	3.0	-0.1	-0.6	0.4
5-8.....	0.3	-0.2	0.9	-1.4	-3.4	0.6	0.6	0.2	1.0
5-9.....	0.8	0.2	1.3	-0.2	-2.1	1.6	0.9	0.6	1.2
10-8.....	-1.1	-1.9	-0.3	-3.0	-5.6	-0.6	-0.8	-1.4	-0.3
2-20.....	0.5	-0.2	1.2	1.9	-	3.8	0.3	-0.2	0.8
3-20.....	0.4	-0.4	1.0	1.5	-0.6	3.6	0.2	-0.3	0.6
14-8.....	-2.3	-3.4	-1.4	-4.8	-7.7	-2.0	-2.0	-2.7	-1.3
14-9.....	-1.9	-2.9	-1.0	-3.6	-6.4	-1.0	-1.7	-2.4	-1.0
14-20.....	-1.6	-2.5	-0.7	-3.1	-5.7	-0.5	-1.4	-2.0	-0.8
Average absolute difference.....	0.7	1.2	0.9	1.8	3.2	2.0	0.7	1.1	0.7

- Represents zero or rounds to zero.

¹Estimated population includes an allowance for 3 million undocumented aliens.

Table 8.3. Undercount Rates from Demographic Analysis and Alternative PEP Estimates for White-and-Other Races, by Age and Sex: 1980

(Base of percents is estimated population. See text for explanation of alternative estimates)

Sex and age group	Demo-graphic analysis ¹	Percent net undercount				Difference from demographic analysis			
		PEP							
		14-8	10-8	3-8	5-8	14-8	10-8	3-8	5-8
White-and-other male									
All ages.....	1.5	-1.3	0.1	0.5	1.7	-2.8	-1.4	-1.0	-0.2
0-4 years	0.6	-0.5	1.2	1.4	3.0	-1.1	0.6	0.8	2.4
5-9 years	0.7	-0.1	0.9	1.2	2.2	-0.8	0.2	0.5	1.5
10-14 years	-0.1	-0.9	-	0.3	0.8	-0.8	0.1	0.4	0.9
15-19 years	0.1	-1.0	-0.1	1.2	2.3	-1.1	-0.2	1.1	2.2
20-24 years	2.0	-0.9	2.2	2.6	6.2	-2.9	0.2	0.6	4.2
25-29 years	3.0	-2.2	0.8	0.5	3.3	-5.2	-2.2	-2.5	0.3
30-34 years	1.9	-1.0	0.8	1.1	2.6	-2.9	-1.1	-0.8	0.7
35-39 years	2.5	-1.4	-0.5	0.5	0.6	-3.9	-3.0	-1.9	-1.9
40-44 years	2.7	-1.0	-0.8	0.2	0.3	-3.7	-3.5	-2.4	-2.4
45-49 years	2.9	-1.8	-0.7	-0.6	0.1	-4.7	-3.6	-3.5	-2.8
50-54 years	2.2	-1.5	-0.6	-0.8	-0.2	-3.7	-2.8	-3.0	-2.4
55-59 years	2.3	-2.3	-1.5	-1.5	-0.7	-4.6	-3.8	-3.8	-3.0
60-64 years	1.7	-1.4	-0.8	-0.5	-0.4	-3.1	-2.5	-2.2	-2.1
65-69 years	-0.3	-1.7	-1.2	-1.2	-1.0	-1.4	-0.9	-0.9	-0.7
70-74 years	-0.2	-1.9	-1.5	-1.3	-1.1	-1.7	-1.3	-1.1	-0.9
75 years and over.....	0.9	-2.5	-1.9	-1.9	-1.5	-3.4	-2.8	-2.8	-2.4
Average absolute difference.....	(x)	(x)	(x)	(x)	(x)	2.9	1.8	1.8	1.8
White-and-other female									
All ages.....	-	-1.2	-0.3	0.2	1.0	-1.2	-0.3	0.2	1.0
0-4 years	0.5	-0.4	0.8	1.6	2.4	-0.9	0.3	1.1	1.9
5-9 years	0.6	-1.2	-0.1	0.3	1.1	-1.8	-0.7	-0.3	0.5
10-14 years	-	-1.1	0.2	0.1	1.6	-1.1	0.2	0.1	1.6
15-19 years	-0.4	-0.2	1.1	2.1	3.3	0.2	1.5	2.5	3.3
20-24 years	-	-1.0	1.3	1.9	4.6	-1.0	1.3	1.9	4.6
25-29 years	0.5	-1.6	-0.1	0.2	1.8	-2.1	-0.6	-0.3	1.3
30-34 years	-0.6	-1.2	0.1	-0.2	1.2	-0.6	0.7	0.4	1.8
35-39 years	-	-1.0	-0.9	-	-0.3	-1.0	-0.9	-	-0.3
40-44 years	-0.1	-0.4	-0.5	0.6	0.2	-0.3	-0.4	0.7	0.3
45-49 years	0.2	-1.2	-0.8	-0.4	-0.2	-1.4	-1.0	-0.6	-0.4
50-54 years	-0.4	-1.9	-0.8	-1.5	-0.3	-1.5	-0.4	-1.1	0.1
55-59 years	-0.9	-2.1	-1.3	-1.5	-0.8	-1.2	-0.4	-0.6	0.1
60-64 years	-0.4	-2.6	-1.6	-1.9	-1.4	-2.2	-1.2	-1.5	-1.0
65-69 years	-1.5	-2.0	-1.7	-1.4	-1.5	-0.5	-0.2	0.1	-
70-74 years	-0.3	-1.7	-1.9	-1.0	-1.7	-1.4	-1.6	-0.7	-1.4
75 years and over.....	2.6	-1.5	-1.7	-0.2	-1.4	-4.1	-4.3	-2.8	-4.0
Average absolute difference.....	(x)	(x)	(x)	(x)	(x)	1.3	1.0	0.9	1.4

- Represents zero or round to zero.

(x) Not applicable.

¹Estimated population includes allowance for 3 million undocumented aliens.

**Table 8.4. Undercount Rates from Demographic Analysis and Alternative PEP Estimates for Blacks, by Age and Sex:
1980**

(Base of percents is estimated population. See text for explanation of alternative estimates)

Sex and age group	Demo-graphic analysis ¹	Percent net undercount				Difference from demographic analysis			
		PEP							
		14-8	10-8	3-8	5-8	14-8	10-8	3-8	5-8
Black male									
All ages	8.8	1.0	3.2	6.3	5.4	-7.8	-5.6	-2.5	-3.4
0-4 years	9.6	2.7	6.0	9.1	8.9	-6.9	-3.6	-0.5	-0.7
5-9 years	6.1	4.0	4.1	9.3	5.6	-2.1	-2.0	3.2	-0.5
10-14 years	1.8	4.6	2.3	9.6	3.9	2.8	0.5	7.8	2.1
15-19 years	0.3	1.7	1.6	5.4	3.8	1.4	1.3	5.1	3.5
20-24 years	8.9	-1.5	4.4	6.2	8.7	-10.4	-4.5	-2.7	-0.2
25-29 years	12.7	-3.9	3.4	3.3	6.3	-16.6	-9.3	-9.4	-6.4
30-34 years	13.4	-1.6	3.6	5.6	5.9	-15.0	-9.8	-7.8	-7.5
35-39 years	16.6	1.5	6.9	7.4	8.5	-15.1	-9.7	-9.2	-8.1
40-44 years	18.5	3.4	2.6	7.0	4.9	-15.1	-15.9	-11.5	-13.6
45-49 years	18.4	0.7	1.3	4.9	2.9	-17.7	-17.1	-13.5	-15.5
50-54 years	15.7	-0.8	1.1	3.7	1.8	-16.5	-14.6	-12.0	-13.9
55-59 years	10.8	2.7	3.5	5.0	4.4	-8.1	-7.3	-5.8	-6.4
60-64 years	6.7	-1.0	-0.4	1.6	0.4	-7.7	-7.1	-5.1	-6.3
65-69 years	-2.9	-0.5	2.2	2.0	3.2	2.4	5.1	4.9	6.1
70-74 years	-1.8	-0.5	2.2	1.9	3.2	1.3	4.0	3.7	5.0
75 years and over	0.6	-5.0	-2.7	-2.6	-1.7	-5.6	-3.3	-3.2	-2.3
Average absolute difference	(x)	(x)	(x)	(x)	(x)	9.0	7.2	6.6	6.1
Black female									
All ages	3.1	1.1	2.5	5.3	3.8	-2.0	-0.6	2.2	0.7
0-4 years	9.0	5.1	5.3	12.6	7.4	-3.9	-3.7	3.6	-1.6
5-9 years	5.6	1.2	4.9	6.1	6.3	-4.4	-0.7	0.5	0.7
10-14 years	1.7	3.3	3.7	7.8	5.1	1.6	2.0	6.1	3.4
15-19 years	-0.2	1.7	3.7	4.5	5.0	1.9	3.9	4.7	5.2
20-24 years	2.8	-0.1	3.8	5.8	5.6	-2.9	1.0	3.0	2.8
25-29 years	3.5	0.7	2.5	6.2	3.7	-2.8	-1.0	2.7	0.2
30-34 years	2.4	1.0	2.7	6.4	5.3	-1.4	0.3	4.0	2.9
35-39 years	3.9	1.2	1.2	4.8	1.8	-2.7	-2.7	0.9	-2.1
40-44 years	5.8	0.7	0.1	2.9	1.0	-5.1	-5.7	-2.9	-4.8
45-49 years	4.9	0.7	-1.6	2.8	-1.2	-4.2	-6.5	-2.1	-6.1
50-54 years	1.9	-0.6	-	0.7	0.6	-2.5	-1.9	-1.2	-1.3
55-59 years	1.8	-0.5	-0.3	1.6	-0.1	-2.3	-2.1	-0.2	-1.9
60-64 years	0.4	-0.4	-1.0	1.4	-0.7	-0.8	-1.4	1.0	-1.1
65-69 years	-6.6	-1.5	0.9	0.2	1.3	5.1	7.5	6.8	7.9
70-74 years	-2.4	-1.6	0.7	-	1.1	0.8	3.1	2.4	3.5
75 years and over	6.4	-1.9	0.5	-0.9	0.9	-8.3	-5.9	-7.3	-5.5
Average absolute difference	(x)	(x)	(x)	(x)	(x)	3.2	3.1	3.1	3.2

- Represents zero or rounds to zero.

(x) Not applicable.

¹Estimated population includes allowance for 3 million undocumented aliens.

Table 8.5. Sex Ratios from Demographic Analysis, PEP Set 14-8, PEP Set 5-9, and the 1980 Census, by Race and Age

(Sex ratio is males per 100 females. See text for explanation of alternative estimates)

Race and age group	Sex ratio				Difference from demographic analysis		
	Demo-graphic analysis ¹	PEP 14-8	PEP 5-9	Census	PEP 14-8	PEP 5-9	Census
Black							
All ages.....	95.2	89.6	91.5	89.6	-5.6	-3.7	-5.6
0-4 years	102.3	99.2	102.8	101.6	-3.1	0.5	-0.7
5-9 years	102.2	104.5	101.1	101.6	2.3	-1.1	-0.6
10-14 years.....	101.2	102.6	99.8	101.2	1.4	-1.4	-
15-19 years.....	100.0	99.5	98.8	99.6	-0.5	-1.2	-0.4
20-24 years.....	97.6	90.3	94.1	91.4	-7.3	-3.5	-6.2
25-29 years.....	97.1	84.1	91.0	87.8	-13.0	-6.1	-9.3
30-34 years.....	96.5	83.7	87.1	85.7	-12.8	-9.4	-10.8
35-39 years.....	96.0	83.5	90.1	83.3	-12.5	-5.9	-12.7
40-44 years.....	95.7	85.1	86.6	82.8	-10.6	-9.1	-12.9
45-49 years.....	95.6	82.1	86.1	82.1	-13.5	-9.5	-13.5
50-54 years.....	94.0	80.8	82.7	80.8	-13.2	-11.3	-13.2
55-59 years.....	90.1	84.5	85.7	81.8	-5.6	-4.4	-8.3
60-64 years.....	84.6	78.9	81.9	79.2	-5.7	-2.7	-5.4
65-69 years.....	77.2	75.2	75.4	74.5	-2.0	-1.8	-2.7
70-74 years.....	71.5	72.0	72.7	71.1	0.5	1.2	-0.4
75 years and over	56.8	58.6	59.5	60.3	1.8	2.7	3.5
Average absolute difference.....	(x)	(x)	(x)	(x)	6.6	4.5	6.3
White-and-other races							
All ages.....	96.5	95.1	95.9	95.1	-1.4	-0.6	-1.4
0-4 years	105.3	105.1	106.1	105.3	-0.2	0.8	-
5-9 years	105.3	106.4	106.3	105.2	1.1	1.0	-0.1
10-14 years.....	104.8	105.1	104.1	104.9	0.3	-0.7	0.1
15-19 years.....	104.4	103.1	102.9	103.9	-1.3	-1.5	-0.5
20-24 years.....	103.6	101.5	103.2	101.4	-2.1	-0.4	-2.2
25-29 years.....	103.0	99.9	102.3	100.5	-3.1	-0.7	-2.5
30-34 years.....	101.7	99.4	100.8	99.2	-2.3	-0.9	-2.5
35-39 years.....	100.7	97.9	99.3	98.3	-2.8	-1.4	-2.4
40-44 years.....	100.2	96.9	97.8	97.5	-3.3	-2.4	-2.7
45-49 years.....	98.7	95.5	96.6	96.0	-3.2	-2.1	-2.7
50-54 years.....	96.2	94.0	94.0	93.6	-2.2	-2.2	-2.6
55-59 years.....	93.1	89.9	90.3	90.2	-3.2	-2.8	-2.9
60-64 years.....	88.8	87.9	87.7	86.9	-0.9	-1.1	-1.9
65-69 years.....	81.5	80.8	80.8	80.5	-0.7	-0.7	-1.0
70-74 years.....	72.5	72.3	73.0	72.5	-0.2	0.5	-
75 years and over	53.9	54.3	54.8	54.9	0.4	0.9	1.0
Average absolute difference.....	(x)	(x)	(x)	(x)	1.7	1.3	1.6

- Represents zero or rounds to zero.

(x) Not applicable.

¹Estimated population includes an allowance for 3 million undocumented aliens.

Table 8.6. Error of Closure from 1980 Postcensal Population Estimates, for Regions

(Numbers in 1000s. Error of closure represents difference between 1980 census and 1980 estimates based on 1970 census count plus estimated intercensal change)

Regions	Population (Estimate of legal residents)		Error of closure	
	1980 census ¹	1980 estimate ²	Amount	Percent
United States.....	224,489	221,393	3,096	1.4
Northeast.....	48,834	48,803	31	0.1
Midwest.....	58,666	58,192	474	0.8
South.....	74,956	72,704	2,252	3.0
West.....	42,034	41,696	338	0.8

¹1980 census population is modified to exclude the estimated 2.06 million undocumented aliens counted in the census. Estimates of undocumented aliens counted in the 1980 census for states are from Jeffrey S. Passel and Karen A. Woodrow, "Geographic Distribution of Undocumented Immigrants: Estimates of Undocumented Aliens Counted in the 1980 Census by State," *International Migration Review*, Vol. 18, (Fall 1984), pp. 642-671.

²1980 estimate represents average of estimates produced by composite method and administrative record method. See *Current Population Reports*, Series P-25, No. 957 for explanation of estimation methodology. Estimates have been revised so that the intercensal change implied by the estimates is consistent with the intercensal change incorporated in the development of the undercount estimates.

Table 8.7. Undercount Rates by Region of Residence Based on Demographic Analysis for 1970 and Alternative PEP Estimates for 1980

(Base of percents is estimated population)

Estimate	United States	Region			
		Northeast	Midwest	South	West
Percent net undercount					
Demographic analysis estimate, 1970 ¹	2.6	1.4	1.4	4.0	3.3
PEP estimate, 1980					
2-8.....	1.1	0.7	1.0	0.7	2.4
2-9.....	1.5	1.1	1.3	1.2	3.1
3-8.....	1.0	0.5	0.9	0.6	2.2
3-9.....	1.4	0.9	1.2	1.0	2.9
5-8.....	1.7	0.8	1.1	1.9	3.2
5-9.....	2.1	1.2	1.4	2.4	3.8
10-8.....	0.3	-0.4	0.2	0.2	1.4
2-20.....	1.9	1.4	1.4	1.6	3.4
3-20.....	1.7	1.2	1.4	1.5	3.2
14-8.....	-1.0	-1.2	-0.6	-1.6	-0.2
14-9.....	-0.5	-0.9	-0.3	-1.1	0.5
14-20.....	-0.2	-0.6	-0.1	-0.7	0.9
Difference in undercount estimates, 1970 to 1980					
2-8.....	1.5	0.7	0.4	3.3	0.9
2-9.....	1.1	0.3	0.1	2.8	0.2
3-8.....	1.6	0.9	0.5	3.4	1.1
3-9.....	1.2	0.5	0.2	3.0	0.4
5-8.....	0.9	0.6	0.3	2.1	0.1
5-9.....	0.5	0.2	-	1.6	-0.5
10-8.....	2.3	1.8	1.2	3.8	1.9
2-20.....	0.7	-	-	2.4	-0.1
3-20.....	0.9	0.2	-	2.5	0.1
14-8.....	3.7	2.6	2.0	5.6	3.5
14-9.....	3.1	2.3	1.7	5.1	2.8
14-20.....	2.8	2.0	1.5	4.7	2.4
Average absolute difference.....	1.2	1.1	0.7	3.4	1.2

¹Estimates represent average of the seven alternative sets of estimates for each region shown in table VII-D of *Current Population Reports*, Series P-23, No. 65. Estimates for 1970 pertain to the legally resident population.

Figure 8.1.

Alternative Net Undercount Rates From Demographic Analysis (DA) and the Post-Enumeration Program (PEP) for the Total Population: 1980

Percent net undercount

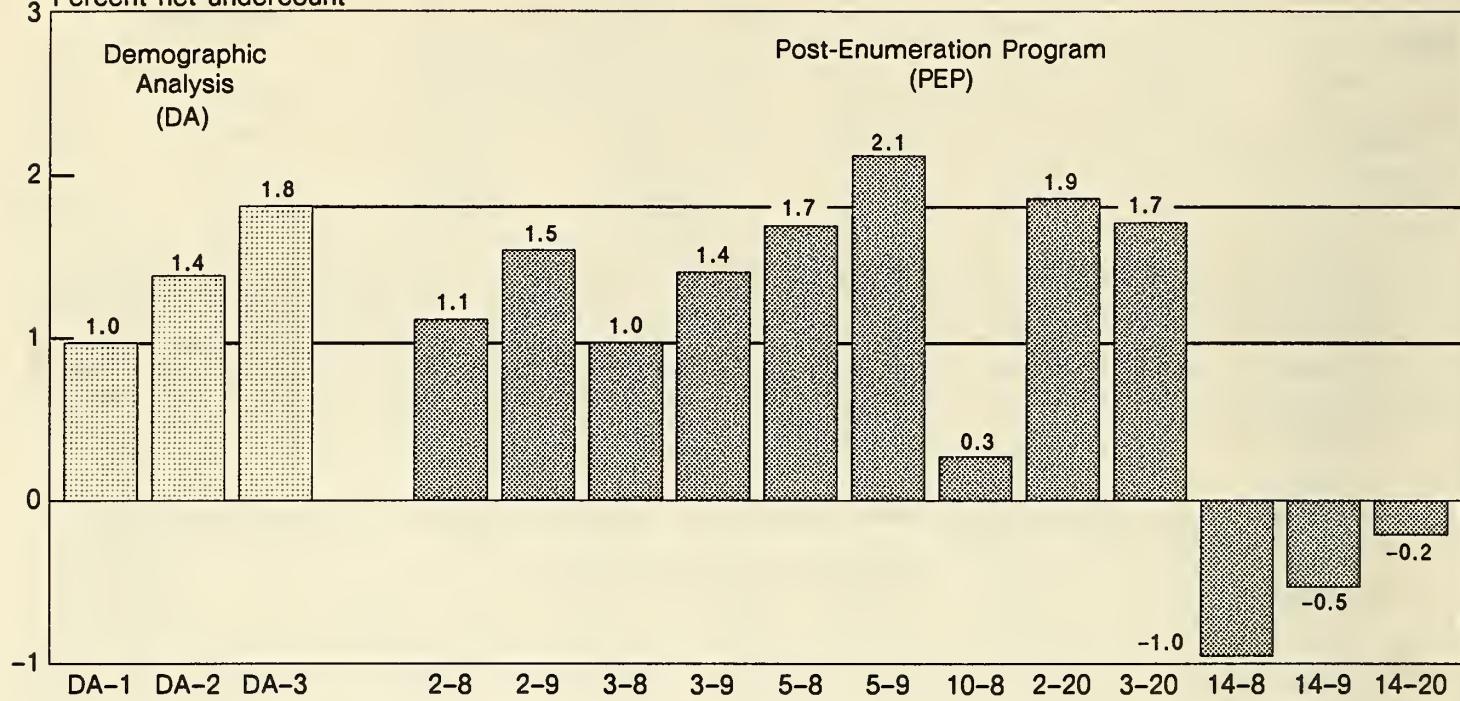


Figure 8.2.
Alternative Net Undercount Rates From Demographic Analysis (DA) and the Post-Enumeration Program (PEP), by Sex for the Total Population: 1980

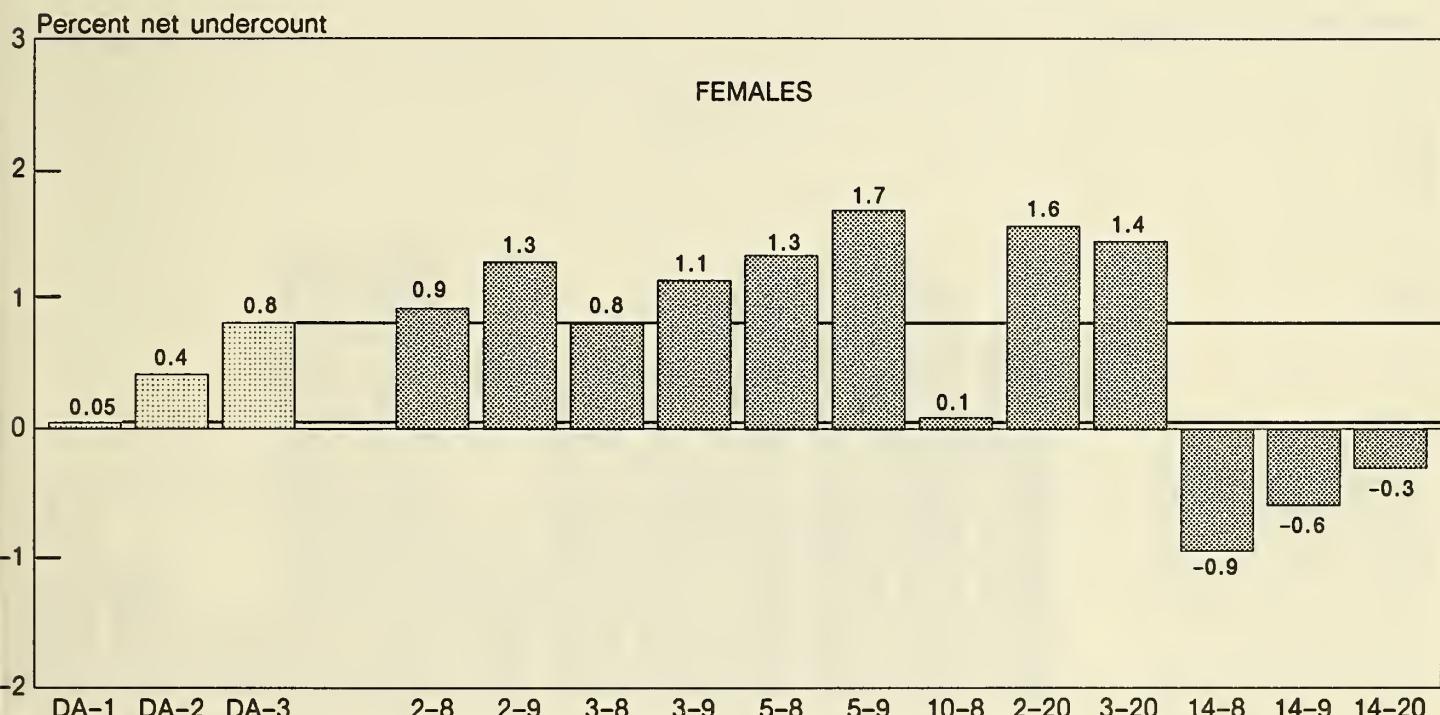
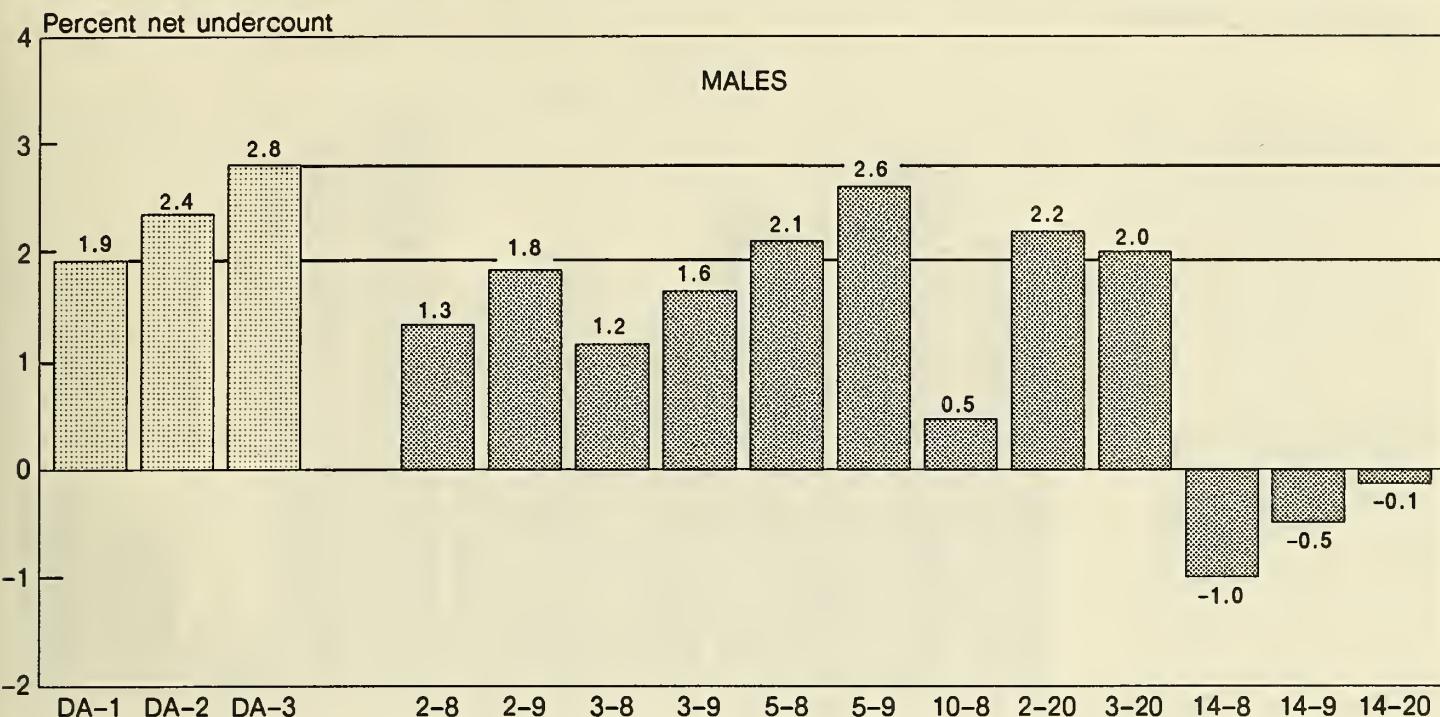
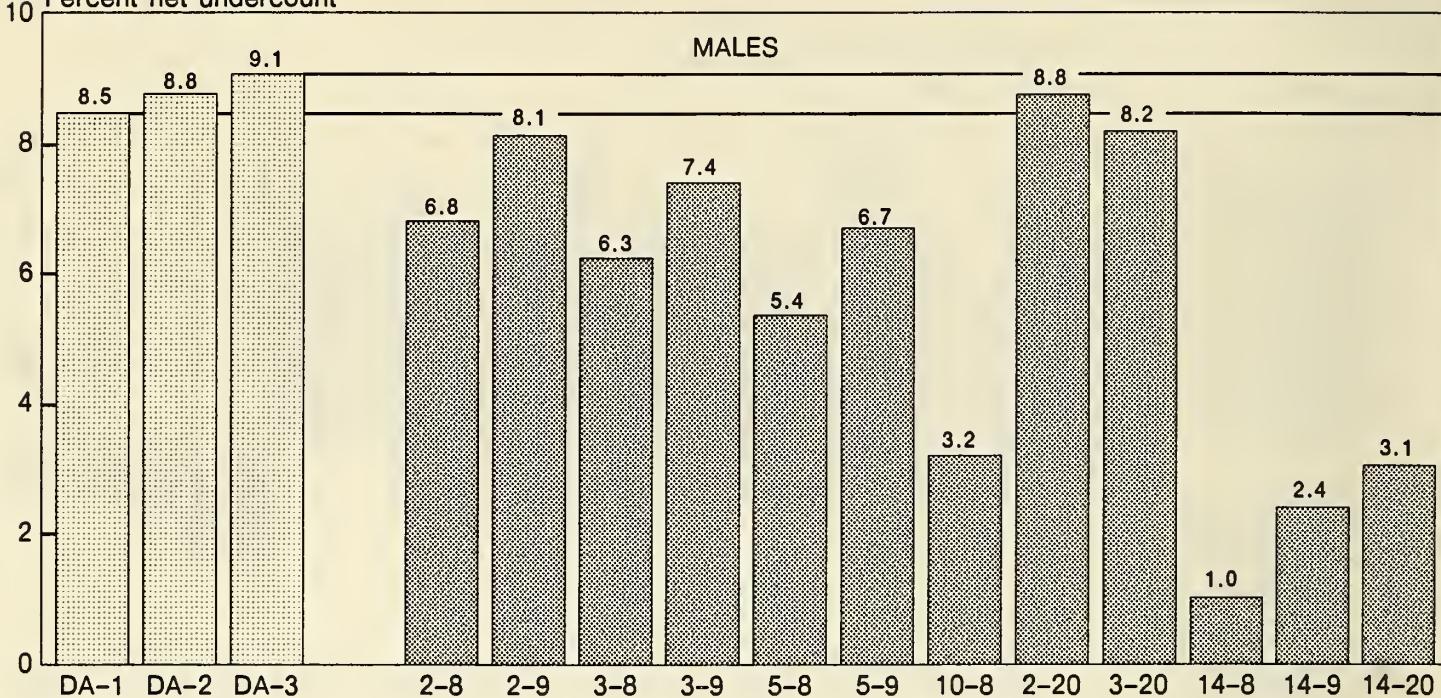


Figure 8.3.

Alternative Net Undercount Rates From Demographic Analysis (DA) and the Post-Enumeration Program (PEP), by Sex for Blacks: 1980

Percent net undercount



Percent net undercount

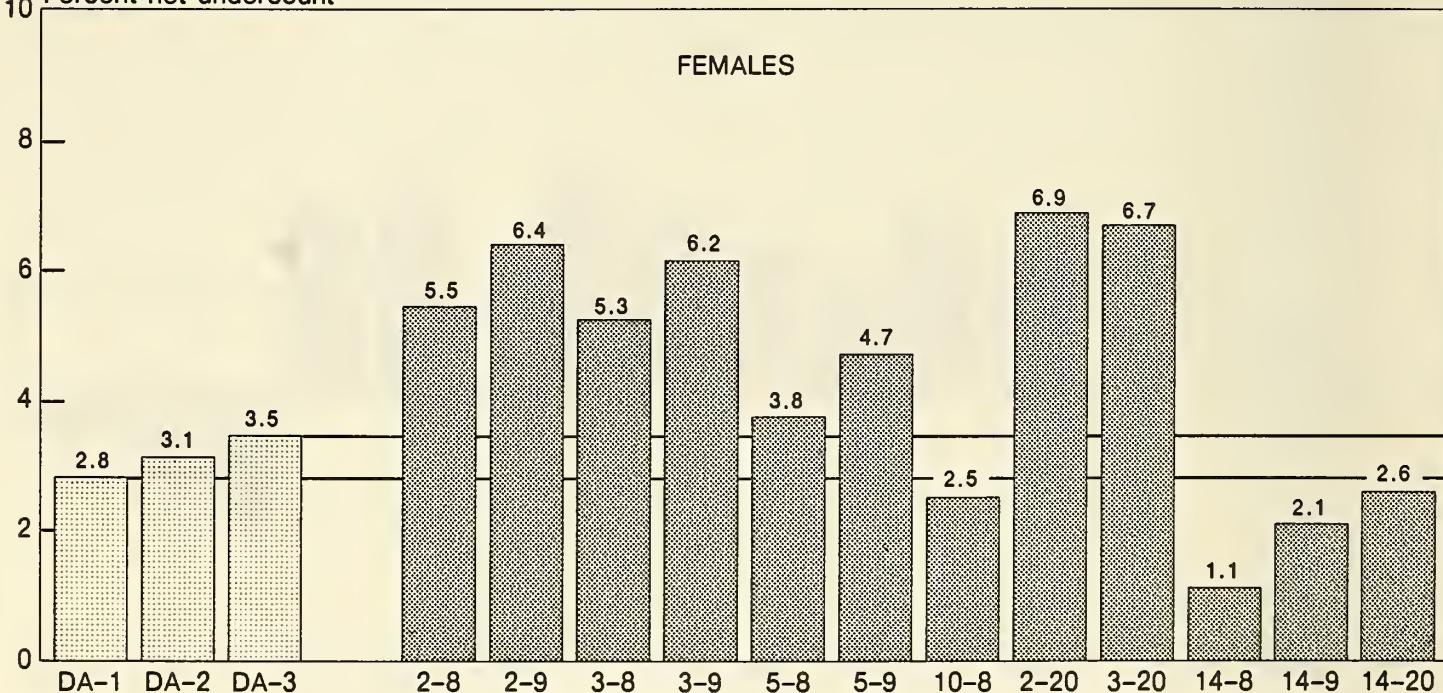
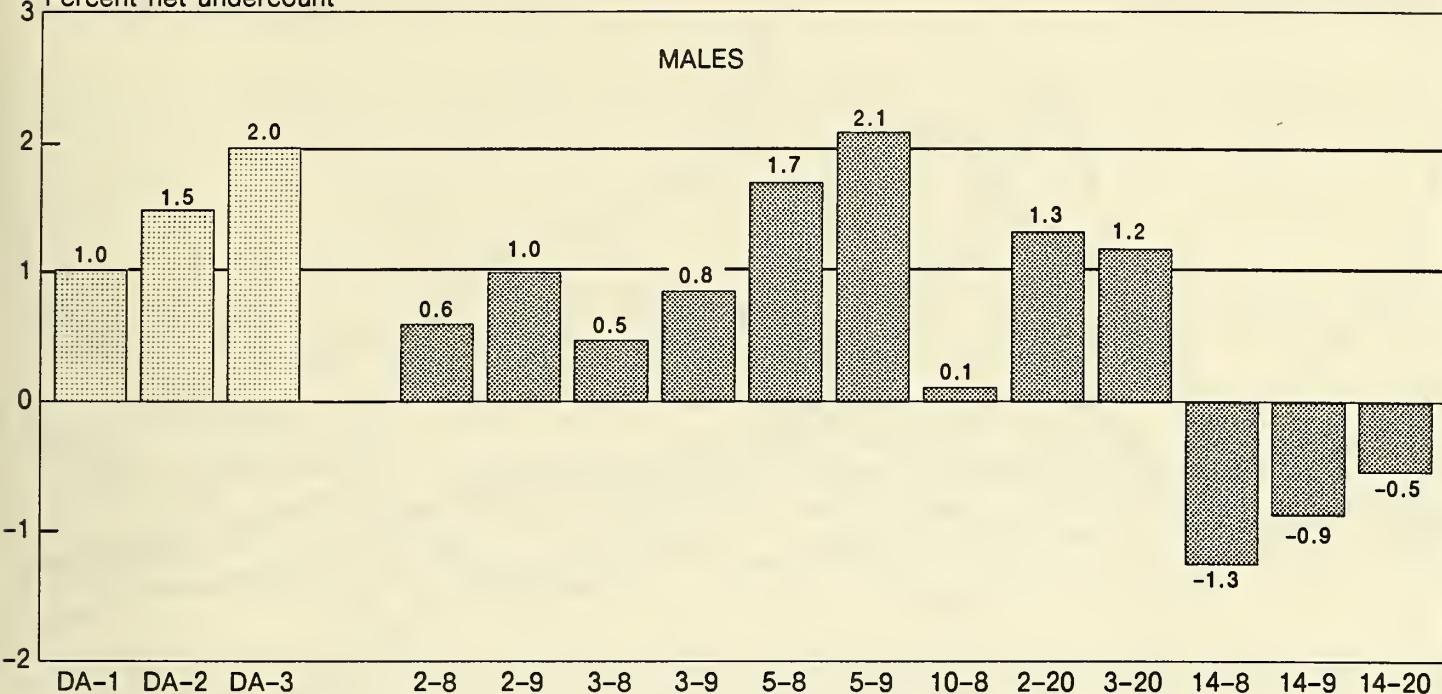


Figure 8.4.

Alternative Net Undercount Rates From Demographic Analysis (DA) and the Post-Enumeration Program (PEP), by Sex for White-and-Other Races: 1980

Percent net undercount



Percent net undercount

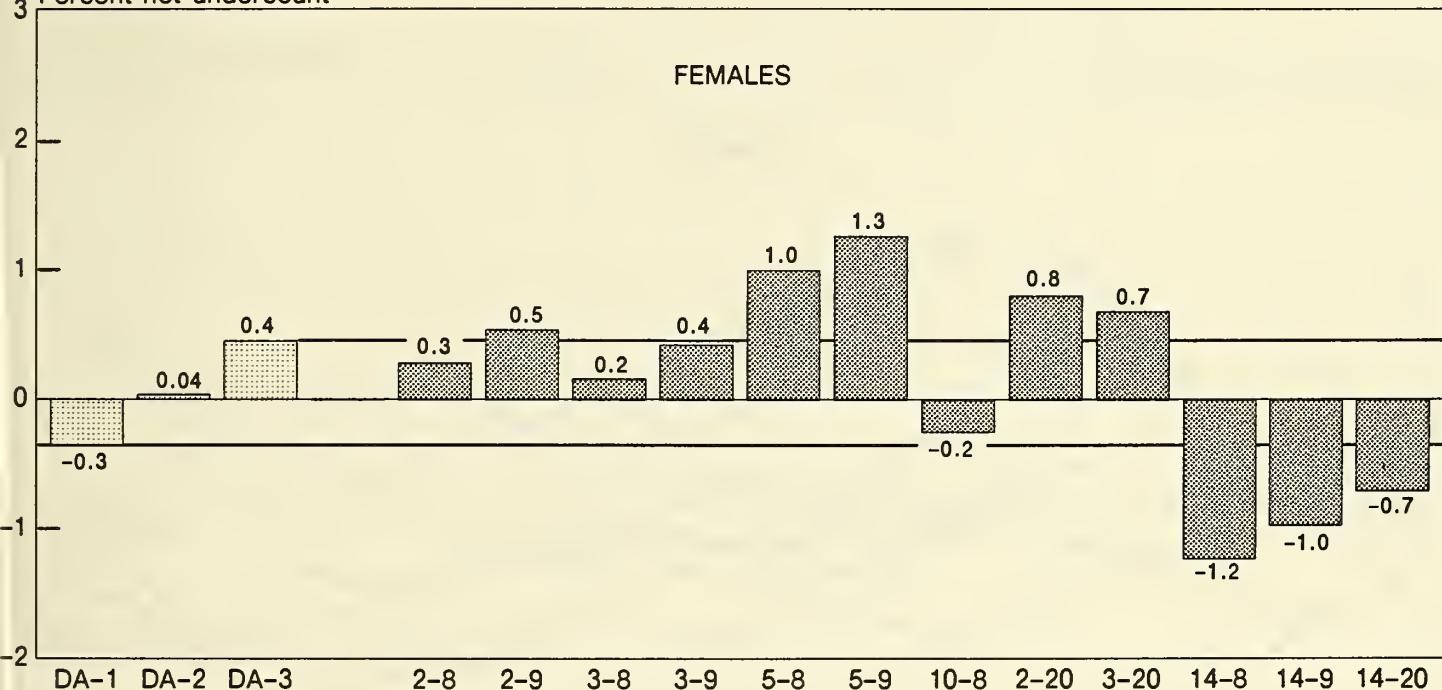
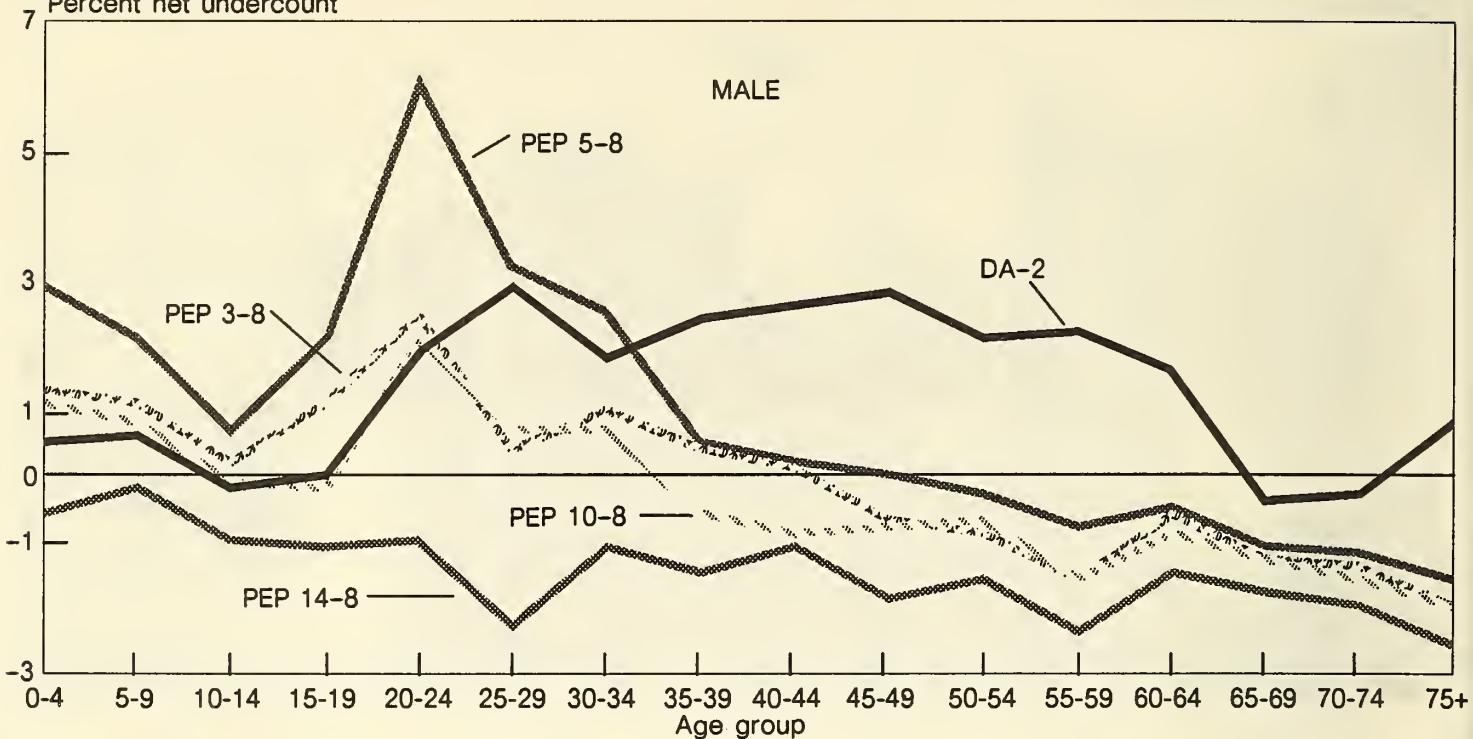


Figure 8.5.

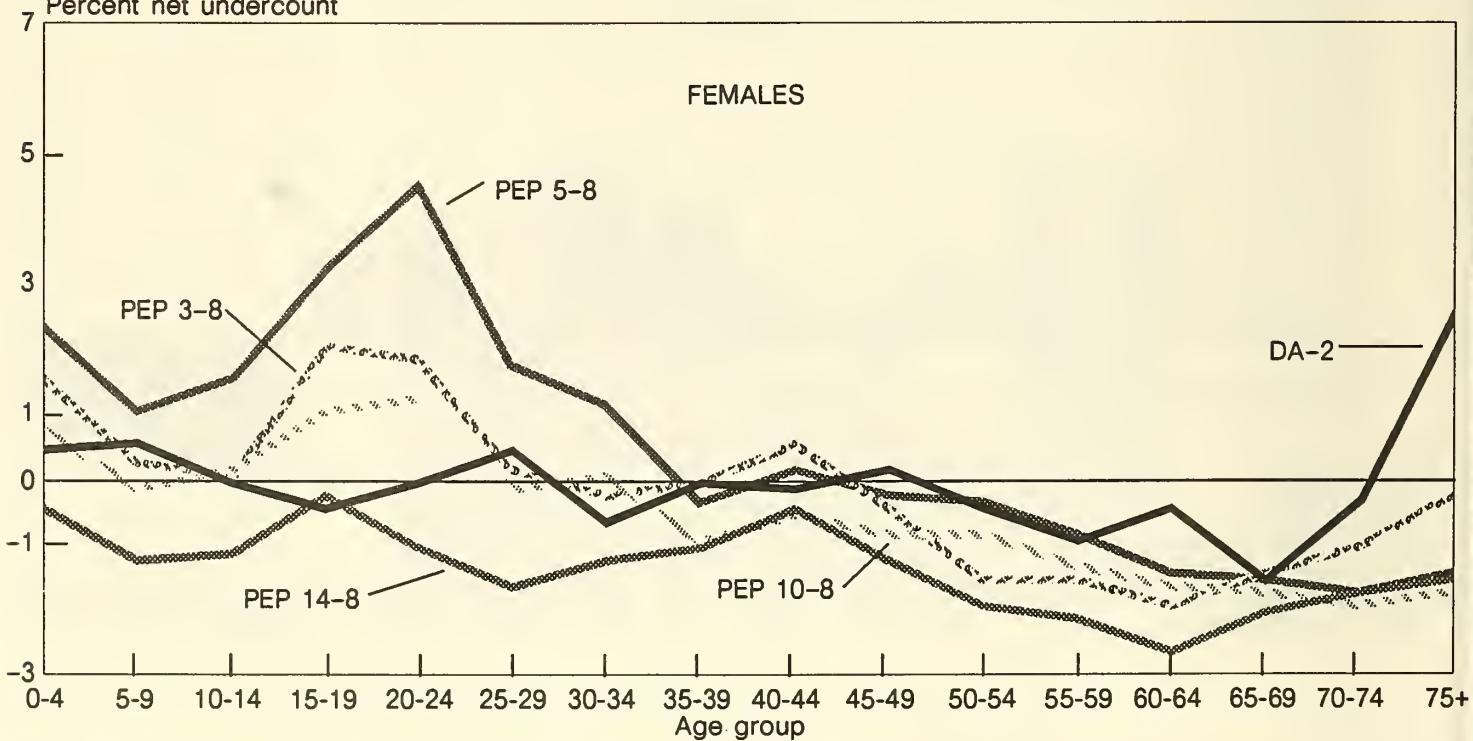
Alternative Net Undercount Rates From Demographic Analysis (DA) and the Post-Enumeration Program (PEP), by Age and Sex for White-and-Other Races: 1980

Percent net undercount



DA-2 Includes 3 million undocumented residents.

Percent net undercount



DA-2 Includes 3 million undocumented residents.

Figure 8.6.
Alternative Net Undercount Rates From Demographic Analysis (DA) and the Post-Enumeration Program (PEP), by Age and Sex for Blacks: 1980

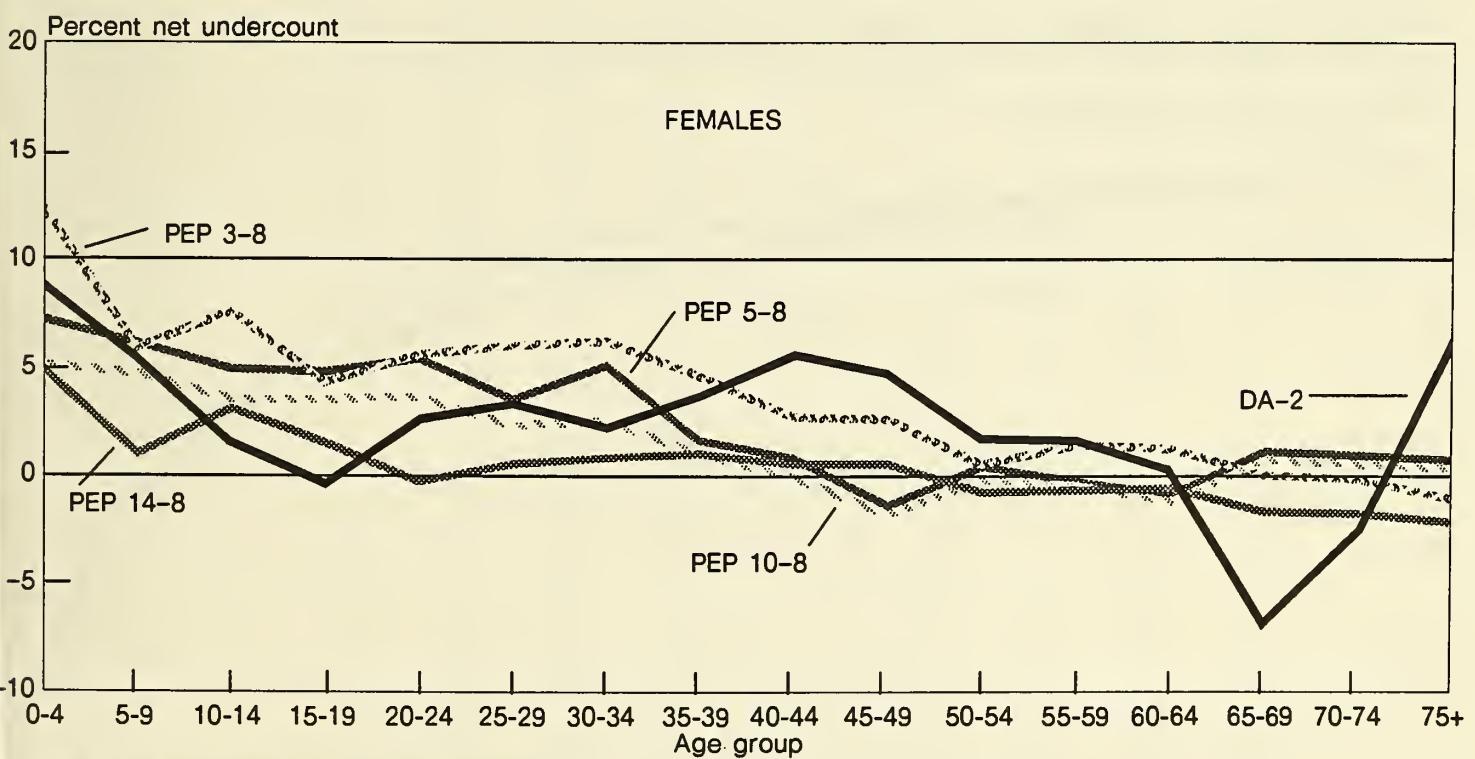
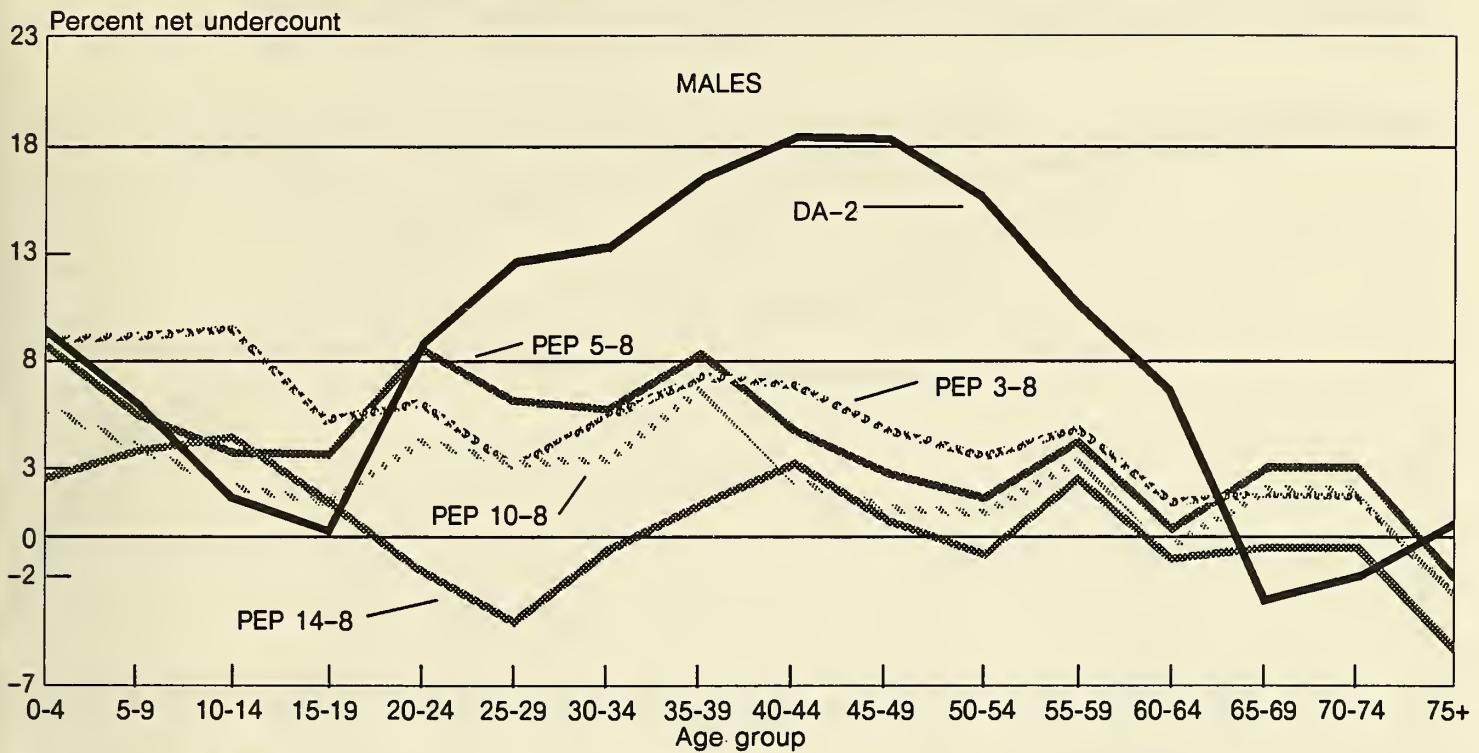


Figure 8.7.

Sex Ratios From the 1980 Census, Demographic Analysis (DA), and Post-Enumeration Program (PEP) Sets 5-9 and 14-8, by Age for Blacks: 1980

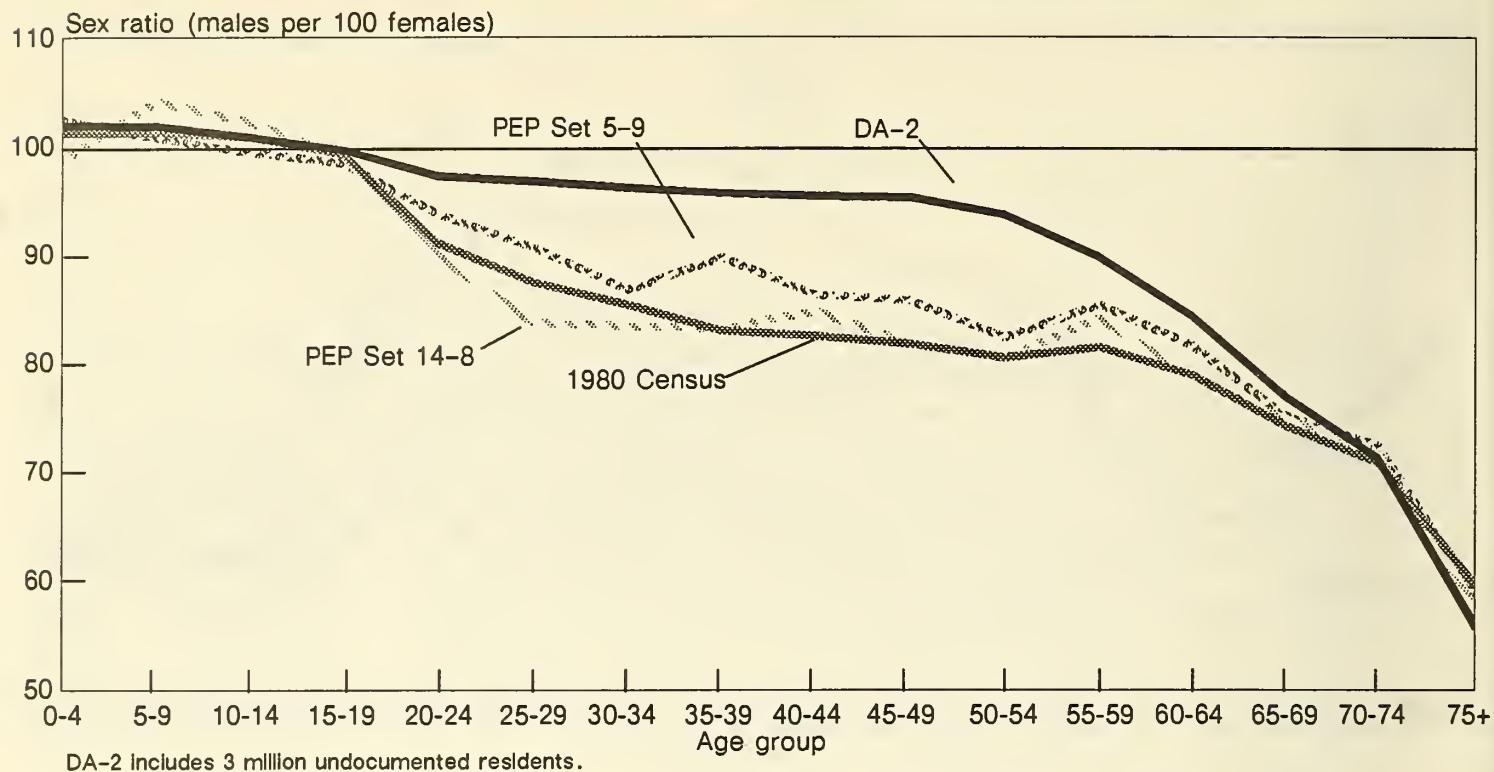
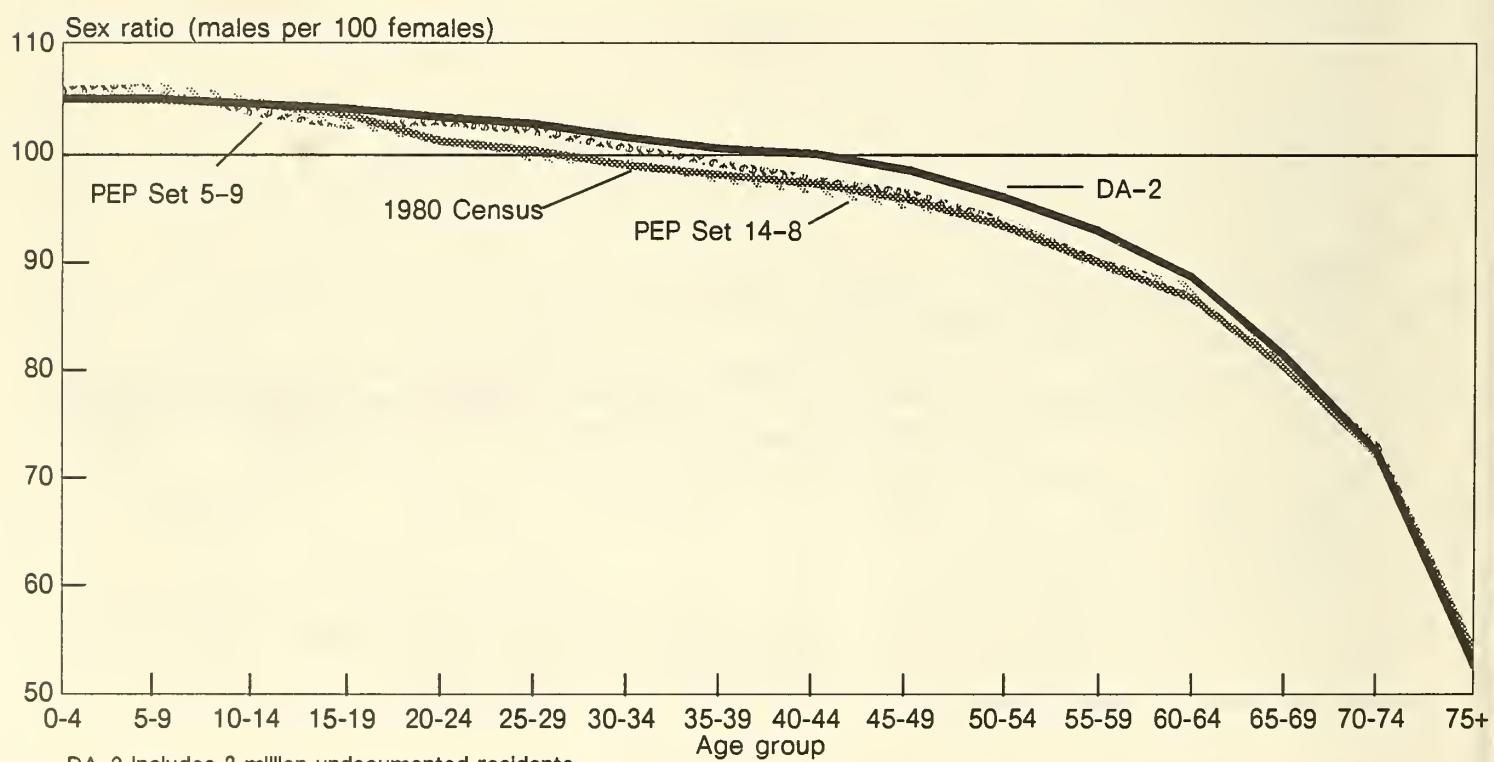


Figure 8.8.

Sex Ratios From the 1980 Census, Demographic Analysis (DA), and Post-Enumeration Program (PEP) Sets 5-9 and 14-8, by Age for White-and-Other Races: 1980



Appendix A.—Detailed Tables of Estimated Population and Amount and Percent of Net Undercount From Demographic Analysis, by Age, Sex, and Race: 1980, 1970, 1960, 1950, and 1940

Table A.80.1. Estimated Population and Amount and Percent of Net Undercount From Demographic Analysis for the Legally Resident Population by Age, Sex, and Race: 1980

(Populations in thousands. All figures rounded independently. A minus sign denotes a net overcount)

Population and age	All races			Black			White-and-other races			White		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
ESTIMATED POPULATION												
All ages.....	226,717	111,132	115,585	28,064	13,686	14,378	198,652	97,446	101,206	193,948	95,177	98,771
Under 5 years.....	16,546	8,469	8,077	2,703	1,367	1,336	13,843	7,102	6,741	13,323	6,838	6,485
5 to 9 years.....	16,749	8,566	8,182	2,653	1,340	1,313	14,096	7,226	6,870	13,605	6,976	6,629
10 to 14 years.....	18,069	9,226	8,842	2,722	1,370	1,352	15,347	7,857	7,490	14,914	7,636	7,278
15 to 19 years.....	20,815	10,587	10,228	2,975	1,487	1,488	17,840	9,100	8,740	17,403	8,877	8,525
20 to 24 years.....	21,109	10,661	10,448	2,874	1,418	1,455	18,235	9,242	8,993	17,807	9,035	8,771
25 to 29 years.....	19,497	9,830	9,667	2,499	1,232	1,267	16,998	8,599	8,400	16,556	8,396	8,160
30 to 34 years.....	17,432	8,752	8,680	2,024	994	1,030	15,408	7,758	7,650	14,990	7,570	7,420
35 to 39 years.....	14,030	7,015	7,014	1,604	785	819	12,426	6,230	6,196	12,102	6,080	6,022
40 to 44 years.....	11,820	5,894	5,926	1,413	691	722	10,407	5,203	5,204	10,147	5,080	5,067
45 to 49 years.....	11,311	5,611	5,700	1,288	630	658	10,023	4,981	5,042	9,805	4,882	4,923
50 to 54 years.....	11,870	5,814	6,056	1,235	599	636	10,635	5,215	5,420	10,444	5,129	5,314
55 to 59 years.....	11,723	5,643	6,080	1,104	524	580	10,619	5,119	5,500	10,458	5,044	5,414
60 to 64 years.....	10,154	4,766	5,388	901	413	487	9,253	4,353	4,901	9,131	4,296	4,835
65 to 69 years.....	8,657	3,879	4,778	740	323	417	7,917	3,557	4,361	7,818	3,509	4,309
70 to 74 years.....	6,762	2,842	3,919	551	230	321	6,210	2,612	3,598	6,138	2,575	3,563
75 years and over	10,174	3,576	6,597	779	282	496	9,395	3,294	6,101	9,309	3,254	6,055
NET UNDERCOUNT												
All ages.....	2,227	2,173	54	1,579	1,169	409	649	1,004	-355	959	1,181	-222
Under 5 years.....	284	151	133	250	130	119	34	21	14	-13	-4	-9
5 to 9 years.....	187	100	87	152	80	72	35	20	15	12	8	5
10 to 14 years.....	-27	-17	-10	43	22	21	-70	-39	-31	-54	-31	-23
15 to 19 years.....	-127	-44	-82	-9	-2	-7	-118	-43	-75	-85	-23	-61
20 to 24 years.....	181	220	-39	156	122	35	25	99	-74	78	132	-54
25 to 29 years.....	347	331	16	190	152	37	157	178	-22	210	209	1
30 to 34 years	142	219	-76	148	129	19	-6	89	-95	53	123	-70
35 to 39 years	240	246	-6	156	128	28	85	118	-33	116	137	-21
40 to 44 years.....	258	243	15	166	127	39	92	117	-24	121	133	-12
45 to 49 years	277	249	29	146	115	31	131	134	-2	153	145	8
50 to 54 years.....	188	206	-18	105	94	11	83	112	-29	104	123	-19
55 to 59 years.....	128	170	-42	66	56	9	62	114	-51	78	122	-44
60 to 64 years.....	77	100	-23	28	27	1	49	73	-24	60	79	-18
65 to 69 years.....	-117	-21	-96	-38	-10	-28	-79	-12	-67	-68	-6	-62
70 to 74 years.....	-31	-10	-21	-12	-4	-8	-18	-6	-13	-11	-2	-9
75 years and over	219	31	188	33	2	31	186	29	156	203	36	167
PERCENT NET UNDERCOUNT*												
All ages.....	1.0	2.0	0.0	5.6	8.5	2.8	0.3	1.0	-0.4	0.5	1.2	-0.2
Under 5 years.....	1.7	1.8	1.6	9.2	9.5	8.9	0.2	0.3	0.2	-0.1	-0.1	-0.1
5 to 9 years.....	1.1	1.2	1.1	5.7	6.0	5.5	0.2	0.3	0.2	0.1	0.1	0.1
10 to 14 years.....	-0.1	-0.2	-0.1	1.6	1.6	1.5	-0.5	-0.5	-0.4	-0.4	-0.4	-0.3
15 to 19 years.....	-0.6	-0.4	-0.8	-0.3	-0.1	-0.5	-0.7	-0.5	-0.9	-0.5	-0.3	-0.7
20 to 24 years.....	0.9	2.1	-0.4	5.4	8.6	2.4	0.1	1.1	-0.8	0.4	1.5	-0.6
25 to 29 years.....	1.8	3.4	0.2	7.6	12.4	3.0	0.9	2.1	-0.3	1.3	2.5	-
30 to 34 years.....	0.8	2.5	-0.9	7.3	13.0	1.8	-	1.2	-1.2	0.4	1.6	-0.9
35 to 39 years.....	1.7	3.5	-0.1	9.7	16.3	3.4	0.7	1.9	-0.5	1.0	2.3	-0.4
40 to 44 years.....	2.2	4.1	0.3	11.7	18.3	5.5	0.9	2.2	-0.5	1.2	2.6	-0.2
45 to 49 years	2.5	4.4	0.5	11.3	18.3	4.7	1.3	2.7	-	1.6	3.0	0.2
50 to 54 years	1.6	3.5	-0.3	8.5	15.7	1.7	0.8	2.1	-0.5	1.0	2.4	-0.3
55 to 59 years.....	1.1	3.0	-0.7	5.9	10.7	1.6	0.6	2.2	-0.9	0.7	2.4	-0.8
60 to 64 years.....	0.8	2.1	-0.4	3.2	6.6	0.2	0.5	1.7	-0.5	0.7	1.8	-0.4
65 to 69 years.....	-1.4	-0.5	-2.0	-5.1	-3.0	-6.8	-1.0	-0.3	-1.5	-0.9	-0.2	-1.4
70 to 74 years	-0.5	-0.4	-0.5	-2.3	-1.9	-2.5	-0.3	-0.2	-0.3	-0.2	-0.1	-0.3
75 years and over	2.1	0.9	2.8	4.2	0.6	6.3	2.0	0.9	2.6	2.2	1.1	2.8

- Represents zero or rounds to zero.

*Base of percent is estimated population.

Note: Estimates compared to census counts adjusted to exclude 2.06 million counted. See text for derivation of estimated population. Estimates compared to census counts classified by modified race.

Table A.80.2. Estimated Population and Amount and Percent of Net Undercount From Demographic Analysis for the Total Resident Population (Based on 2.06 Million Undocumented Residents Counted in 1980) by Age, Sex, and Race: 1980

(Populations in thousands. All figures rounded independently. A minus sign denotes a net overcount)

Population and age	All races			Black			White-and-other races			White		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
ESTIMATED POPULATION												
All ages	228,773	112,226	116,547	28,262	13,782	14,481	200,511	98,444	102,067	195,672	96,105	99,566
Under 5 years	16,632	8,513	8,119	2,709	1,370	1,339	13,923	7,143	6,780	13,401	6,878	6,523
5 to 9 years	16,887	8,639	8,248	2,662	1,345	1,317	14,226	7,294	6,932	13,729	7,041	6,688
10 to 14 years	18,215	9,299	8,916	2,734	1,376	1,359	15,481	7,924	7,557	15,041	7,699	7,342
15 to 19 years	21,041	10,711	10,330	2,998	1,499	1,499	18,044	9,212	8,831	17,596	8,985	8,611
20 to 24 years	21,500	10,884	10,616	2,906	1,435	1,471	18,594	9,449	9,145	18,150	9,234	8,916
25 to 29 years	19,867	10,036	9,832	2,532	1,247	1,284	17,336	8,788	8,547	16,868	8,572	8,296
30 to 34 years	17,703	8,895	8,808	2,052	1,008	1,044	15,651	7,888	7,763	15,210	7,688	7,522
35 to 39 years	14,206	7,108	7,098	1,624	795	829	12,581	6,312	6,269	12,238	6,151	6,086
40 to 44 years	11,928	5,952	5,976	1,426	697	729	10,502	5,254	5,247	10,231	5,124	5,107
45 to 49 years	11,367	5,637	5,730	1,296	634	662	10,071	5,003	5,068	9,847	4,901	4,946
50 to 54 years	11,898	5,826	6,072	1,240	601	639	10,658	5,225	5,433	10,464	5,139	5,326
55 to 59 years	11,743	5,652	6,091	1,107	525	582	10,636	5,127	5,509	10,472	5,050	5,422
60 to 64 years	10,165	4,770	5,395	902	414	489	9,263	4,356	4,906	9,139	4,300	4,839
65 to 69 years	8,665	3,882	4,784	741	323	418	7,924	3,559	4,365	7,824	3,511	4,313
70 to 74 years	6,767	2,843	3,924	552	231	322	6,215	2,613	3,602	6,142	2,576	3,566
75 years and over	10,187	3,579	6,608	781	283	498	9,407	3,296	6,110	9,320	3,257	6,063
NET UNDERCOUNT												
All ages	2,227	2,173	54	1,579	1,169	409	649	1,004	-355	959	1,181	-222
Under 5 years	284	151	133	250	130	119	34	21	14	-13	-4	-9
5 to 9 years	187	100	87	152	80	72	35	20	15	12	8	5
10 to 14 years	-27	-17	-10	43	22	21	-70	-39	-31	-54	-31	-23
15 to 19 years	-127	-44	-82	-9	-2	-7	-118	-43	-75	-85	-23	-61
20 to 24 years	181	220	-39	156	122	35	25	99	-74	78	132	-54
25 to 29 years	347	331	16	190	152	37	157	178	-22	210	209	1
30 to 34 years	142	219	-76	148	129	19	-6	89	-95	53	123	-70
35 to 39 years	240	246	-6	156	128	28	85	118	-33	116	137	-21
40 to 44 years	258	243	15	166	127	39	92	117	-24	121	133	-12
45 to 49 years	277	249	29	146	115	31	131	134	-2	153	145	8
50 to 54 years	188	206	-18	105	94	11	83	112	-29	104	123	-19
55 to 59 years	128	170	-42	66	56	9	62	114	-51	78	122	-44
60 to 64 years	77	100	-23	28	27	1	49	73	-24	60	79	-18
65 to 69 years	-117	-21	-96	-38	-10	-28	-79	-12	-67	-68	-6	-62
70 to 74 years	-31	-10	-21	-12	-4	-8	-18	-6	-13	-11	-2	-9
75 years and over	219	31	188	33	2	31	186	29	156	203	36	167
PERCENT NET UNDERCOUNT*												
All ages	1.0	1.9	-	5.6	8.5	2.8	0.3	1.0	-0.3	0.5	1.2	-0.2
Under 5 years	1.7	1.8	1.6	9.2	9.5	8.9	0.2	0.3	0.2	-0.1	-0.1	-0.1
5 to 9 years	1.1	1.2	1.1	5.7	6.0	5.5	0.2	0.3	0.2	0.1	0.1	0.1
10 to 14 years	-0.1	-0.2	-0.1	1.6	1.6	1.5	-0.5	-0.5	-0.4	-0.4	-0.4	-0.3
15 to 19 years	-0.6	-0.4	-0.8	-0.3	-0.1	-0.5	-0.7	-0.5	-0.8	-0.5	-0.3	-0.7
20 to 24 years	0.8	2.0	-0.4	5.4	8.5	2.4	0.1	1.0	-0.8	0.4	1.4	-0.6
25 to 29 years	1.7	3.3	0.2	7.5	12.2	2.9	0.9	2.0	-0.3	1.2	2.4	-
30 to 34 years	0.8	2.5	-0.9	7.2	12.8	1.8	-	1.1	-1.2	0.3	1.6	-0.9
35 to 39 years	1.7	3.5	-0.1	9.6	16.1	3.3	0.7	1.9	-0.5	0.9	2.2	-0.4
40 to 44 years	2.2	4.1	0.3	11.6	18.2	5.4	0.9	2.2	-0.5	1.2	2.6	-0.2
45 to 49 years	2.4	4.4	0.5	11.3	18.2	4.6	1.3	2.7	-	1.6	3.0	0.2
50 to 54 years	1.6	3.5	-0.3	8.5	15.6	1.7	0.8	2.1	-0.5	1.0	2.4	-0.3
55 to 59 years	1.1	3.0	-0.7	5.9	10.7	1.6	0.6	2.2	-0.9	0.7	2.4	-0.8
60 to 64 years	0.8	2.1	-0.4	3.1	6.6	0.2	0.5	1.7	-0.5	0.7	1.8	-0.4
65 to 69 years	-1.4	-0.5	-2.0	-5.1	-3.0	-6.8	-1.0	-0.3	-1.5	-0.9	-0.2	-1.4
70 to 74 years	-0.5	-0.4	-0.5	-2.3	-1.9	-2.5	-0.3	-0.2	-0.3	-0.2	-0.1	-0.3
75 years and over	2.1	0.9	2.8	4.2	0.6	6.3	2.0	0.9	2.6	2.2	1.1	2.8

* Represents zero or rounds to zero.

* Base of percent is estimated population.

Note: Estimates include an allowance for 2.06 million undocumented residents counted in the 1980 census. See text for derivation of estimated population. Estimates compared to census counts classified by modified race.

Table A.80.3. Estimated Population and Amount and Percent of Net Undercount From Demographic Analysis for the Total Resident Population (Based on 3 Million Undocumented Residents in 1980) by Age, Sex, and Race: 1980

(Populations in thousands. All figures rounded independently. A minus sign denotes a net overcount)

Population and age	All races			Black			White-and-other races			White		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
ESTIMATED POPULATION												
All ages	229,717	112,728	116,989	28,353	13,825	14,527	201,364	98,902	102,461	196,462	96,531	99,931
Under 5 years	16,672	8,533	8,139	2,712	1,371	1,340	13,961	7,162	6,799	13,437	6,896	6,540
5 to 9 years	16,951	8,673	8,278	2,666	1,347	1,318	14,285	7,325	6,960	13,786	7,071	6,715
10 to 14 years	18,282	9,333	8,949	2,740	1,378	1,361	15,543	7,955	7,588	15,099	7,728	7,371
15 to 19 years	21,145	10,768	10,377	3,008	1,504	1,504	18,137	9,264	8,873	17,685	9,035	8,651
20 to 24 years	21,679	10,986	10,693	2,920	1,442	1,478	18,759	9,544	9,215	18,307	9,325	8,982
25 to 29 years	20,037	10,130	9,907	2,547	1,255	1,292	17,490	8,875	8,615	17,011	8,653	8,359
30 to 34 years	17,828	8,961	8,866	2,065	1,014	1,051	15,763	7,947	7,815	15,311	7,742	7,569
35 to 39 years	14,286	7,150	7,136	1,634	800	834	12,653	6,350	6,303	12,300	6,184	6,116
40 to 44 years	11,977	5,978	5,999	1,432	700	732	10,545	5,278	5,267	10,269	5,144	5,125
45 to 49 years	11,393	5,649	5,744	1,300	636	664	10,093	5,013	5,080	9,866	4,909	4,956
50 to 54 years	11,911	5,832	6,079	1,242	602	640	10,669	5,230	5,439	10,474	5,143	5,331
55 to 59 years	11,752	5,656	6,097	1,108	525	583	10,644	5,130	5,513	10,479	5,053	5,426
60 to 64 years	10,170	4,772	5,398	903	414	489	9,267	4,358	4,909	9,142	4,301	4,841
65 to 69 years	8,669	3,883	4,786	742	323	419	7,927	3,560	4,368	7,826	3,512	4,315
70 to 74 years	6,770	2,844	3,926	553	231	322	6,217	2,613	3,604	6,144	2,577	3,568
75 years and over	10,194	3,581	6,613	781	283	498	9,412	3,298	6,115	9,325	3,258	6,067
NET UNDERCOUNT												
All ages	3,171	2,675	496	1,669	1,213	456	1,501	1,462	40	1,750	1,607	143
Under 5 years	324	171	153	252	132	121	71	40	32	23	14	8
5 to 9 years	251	134	117	156	83	74	95	51	44	69	38	32
10 to 14 years	40	17	24	49	25	24	-8	-8	-	4	-2	6
15 to 19 years	-23	13	-36	1	4	-2	-24	9	-33	4	26	-22
20 to 24 years	360	323	38	171	129	42	189	194	-4	235	223	12
25 to 29 years	516	425	91	205	160	45	311	265	46	354	290	64
30 to 34 years	267	284	-18	161	135	25	106	149	-43	154	177	-23
35 to 39 years	321	288	33	165	133	32	156	156	-	178	170	8
40 to 44 years	308	270	38	172	129	42	136	140	-4	159	153	6
45 to 49 years	303	261	42	150	117	33	153	144	10	172	154	18
50 to 54 years	201	212	-10	107	95	12	94	117	-23	114	127	-13
55 to 59 years	137	174	-37	67	57	10	70	117	-47	85	125	-40
60 to 64 years	83	102	-20	29	28	2	53	75	-22	64	80	-16
65 to 69 years	-113	-20	-93	-37	-9	-28	-76	-11	-65	-66	-5	-60
70 to 74 years	-28	-10	-19	-12	-4	-8	-16	-5	-11	-9	-1	-7
75 years and over	225	32	193	34	2	32	191	31	161	208	37	171
PERCENT NET UNDERCOUNT*												
All ages	1.4	2.4	0.4	5.9	8.8	3.1	0.7	1.5	-	0.9	1.7	0.1
Under 5 years	1.9	2.0	1.9	9.3	9.6	9.0	0.5	0.6	0.5	0.2	0.2	0.1
5 to 9 years	1.5	1.5	1.4	5.9	6.1	5.6	0.7	0.7	0.6	0.5	0.5	0.5
10 to 14 years	0.2	0.2	0.3	1.8	1.8	1.7	-0.1	-0.1	-	-	-	0.1
15 to 19 years	-0.1	0.1	-0.3	-	0.3	-0.2	-0.1	0.1	-0.4	-	0.3	-0.3
20 to 24 years	1.7	2.9	0.4	5.9	8.9	2.8	1.0	2.0	0.0	1.3	2.4	0.1
25 to 29 years	2.6	4.2	0.9	8.0	12.7	3.5	1.8	3.0	0.5	2.1	3.3	0.8
30 to 34 years	1.5	3.2	-0.2	7.8	13.4	2.4	0.7	1.9	-0.6	1.0	2.3	-0.3
35 to 39 years	2.2	4.0	0.5	10.1	16.6	3.9	1.2	2.5	-	1.4	2.7	0.1
40 to 44 years	2.6	4.5	0.6	12.0	18.5	5.8	1.3	2.7	-0.1	1.5	3.0	0.1
45 to 49 years	2.7	4.6	0.7	11.5	18.4	4.9	1.5	2.9	0.2	1.7	3.1	0.4
50 to 54 years	1.7	3.6	-0.2	8.6	15.7	1.9	0.9	2.2	-0.4	1.1	2.5	-0.3
55 to 59 years	1.2	3.1	-0.6	6.1	10.8	1.8	0.7	2.3	-0.9	0.8	2.5	-0.7
60 to 64 years	0.8	2.1	-0.4	3.2	6.7	0.4	0.6	1.7	-0.4	0.7	1.9	-0.3
65 to 69 years	-1.3	-0.5	-1.9	-5.0	-2.9	-6.6	-1.0	-0.3	-1.5	-0.8	-0.2	-1.4
70 to 74 years	-0.4	-0.3	-0.5	-2.2	-1.8	-2.4	-0.3	-0.2	-0.3	-0.1	-0.1	-0.2
75 years and over	2.2	0.9	2.9	4.3	0.6	6.4	2.0	0.9	2.6	2.2	1.1	2.8

- Represents zero or rounds to zero.

*Base of percent is estimated population.

Note: Estimates include an allowance for 3 million undocumented residents in 1980. See text for derivation of estimated population. Estimates compared to census counts classified by modified race.

Table A.80.4. Estimated Population and Amount and Percent of Net Undercount From Demographic Analysis for the Total Resident Population (Based on 4 Million Undocumented Residents in 1980) by Age, Sex, and Race: 1980

(Populations in thousands. All figures rounded independently. A minus sign denotes a net overcount)

Population and age	All races			Black			White-and-other races			White		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
ESTIMATED POPULATION												
All ages	230,717	113,260	117,457	28,449	13,872	14,577	202,268	99,388	102,880	197,300	96,982	100,318
Under 5 years	16,714	8,555	8,159	2,714	1,373	1,342	14,000	7,182	6,818	13,475	6,916	6,559
5 to 9 years	17,018	8,708	8,310	2,670	1,350	1,320	14,348	7,358	6,990	13,846	7,103	6,743
10 to 14 years	18,354	9,369	8,985	2,746	1,381	1,365	15,608	7,987	7,621	15,160	7,759	7,401
15 to 19 years	21,255	10,828	10,427	3,019	1,510	1,509	18,236	9,319	8,917	17,780	9,087	8,692
20 to 24 years	21,869	11,094	10,775	2,936	1,450	1,486	18,933	9,644	9,289	18,474	9,422	9,052
25 to 29 years	20,217	10,230	9,987	2,563	1,262	1,300	17,654	8,968	8,687	17,163	8,738	8,425
30 to 34 years	17,960	9,031	8,928	2,078	1,021	1,058	15,881	8,011	7,871	15,418	7,799	7,619
35 to 39 years	14,372	7,195	7,177	1,644	805	839	12,728	6,390	6,339	12,366	6,218	6,147
40 to 44 years	12,029	6,006	6,024	1,438	703	735	10,591	5,302	5,289	10,310	5,165	5,144
45 to 49 years	11,420	5,661	5,759	1,304	637	667	10,116	5,024	5,092	9,886	4,919	4,967
50 to 54 years	11,925	5,838	6,087	1,244	603	642	10,681	5,236	5,445	10,484	5,148	5,336
55 to 59 years	11,762	5,660	6,102	1,110	526	584	10,652	5,134	5,518	10,486	5,057	5,430
60 to 64 years	10,176	4,774	5,401	904	414	490	9,271	4,360	4,911	9,146	4,303	4,843
65 to 69 years	8,673	3,884	4,789	743	323	419	7,930	3,561	4,370	7,829	3,512	4,317
70 to 74 years	6,773	2,844	3,928	553	231	323	6,219	2,614	3,605	6,146	2,577	3,569
75 years and over	10,200	3,582	6,618	782	283	499	9,418	3,299	6,119	9,331	3,259	6,072
NET UNDERCOUNT												
All ages	4,171	3,207	964	1,766	1,260	506	2,405	1,947	458	2,588	2,058	530
Under 5 years	366	193	173	255	133	122	111	60	51	61	34	27
5 to 9 years	318	169	149	161	85	76	158	84	74	130	70	60
10 to 14 years	112	52	59	54	28	27	57	24	33	65	29	36
15 to 19 years	87	73	14	12	9	3	75	64	11	99	79	20
20 to 24 years	550	431	119	186	137	49	364	294	70	402	320	82
25 to 29 years	696	525	171	221	167	53	475	357	118	505	375	130
30 to 34 years	399	354	44	174	142	32	224	212	12	261	234	27
35 to 39 years	407	333	73	175	138	37	232	196	36	244	204	39
40 to 44 years	360	297	63	178	132	46	182	165	17	200	174	26
45 to 49 years	330	273	57	154	119	35	176	154	22	193	163	29
50 to 54 years	215	218	-3	110	96	14	105	122	-17	124	132	-8
55 to 59 years	147	178	-31	69	57	11	78	121	-43	92	128	-36
60 to 64 years	88	104	-17	30	28	2	58	77	-19	68	82	-14
65 to 69 years	-109	-19	-90	-37	-9	-27	-73	-10	-63	-63	-5	-58
70 to 74 years	-26	-9	-16	-12	-4	-7	-14	-5	-9	-7	-1	-6
75 years and over	232	34	198	34	2	32	197	32	165	214	38	175
PERCENT NET UNDERCOUNT*												
All ages	1.8	2.8	0.8	6.2	9.1	3.5	1.2	2.0	0.4	1.3	2.1	0.5
Under 5 years	2.2	2.3	2.1	9.4	9.7	9.1	0.8	0.8	0.7	0.5	0.5	0.4
5 to 9 years	1.9	1.9	1.8	6.0	6.3	5.7	1.1	1.1	1.1	0.9	1.0	0.9
10 to 14 years	0.6	0.6	0.7	2.0	2.0	2.0	0.4	0.3	0.4	0.4	0.4	0.5
15 to 19 years	0.4	0.7	0.1	0.4	0.6	0.2	0.4	0.7	0.1	0.6	0.9	0.2
20 to 24 years	2.5	3.9	1.1	6.3	9.4	3.3	1.9	3.0	0.8	2.2	3.4	0.9
25 to 29 years	3.4	5.1	1.7	8.6	13.2	4.1	2.7	4.0	1.4	2.9	4.3	1.5
30 to 34 years	2.2	3.9	0.5	8.4	13.9	3.1	1.4	2.7	0.2	1.7	3.0	0.4
35 to 39 years	2.8	4.6	1.0	10.6	17.1	4.4	1.8	3.1	0.6	2.0	3.3	0.6
40 to 44 years	3.0	5.0	1.0	12.4	18.8	6.2	1.7	3.1	0.3	1.9	3.4	0.5
45 to 49 years	2.9	4.8	1.0	11.8	18.6	5.3	1.7	3.1	0.4	1.9	3.3	0.6
50 to 54 years	1.8	3.7	-	8.8	15.9	2.2	1.0	2.3	-0.3	1.2	2.6	-0.1
55 to 59 years	1.2	3.1	-0.5	6.2	10.9	1.9	0.7	2.3	-0.8	0.9	2.5	-0.7
60 to 64 years	0.9	2.2	-0.3	3.3	6.7	0.5	0.6	1.8	-0.4	0.7	1.9	-0.3
65 to 69 years	-1.3	-0.5	-1.9	-4.9	-2.9	-6.5	-0.9	-0.3	-1.4	-0.8	-0.1	-1.4
70 to 74 years	-0.4	-0.3	-0.4	-2.1	-1.8	-2.3	-0.2	-0.2	-0.2	-0.1	-	-0.2
75 years and over	2.3	0.9	3.0	4.4	0.7	6.5	2.1	1.0	2.7	2.3	1.2	2.9

- Represents zero or rounds to zero.

*Base of percent is estimated population.

Note: Estimates include an allowance for 4 million undocumented residents in 1980. See text for derivation of estimated population. Estimates compared to census counts classified by modified race.

Table A.80.5. Estimated Population and Amount and Percent of Net Undercount From Demographic Analysis for the Total Resident Population (Based on 5 Million Undocumented Residents in 1980) by Age, Sex, and Race: 1980

(Populations in thousands. All figures rounded independently. A minus sign denotes a net overcount)

Population and age	All races			Black			White-and-other races			White		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
ESTIMATED POPULATION												
All ages	231,717	113,792	117,925	28,545	13,918	14,627	203,171	99,873	103,298	198,138	97,434	100,704
Under 5 years	16,756	8,577	8,180	2,717	1,374	1,343	14,039	7,202	6,837	13,513	6,935	6,577
5 to 9 years	17,086	8,743	8,342	2,674	1,352	1,322	14,411	7,391	7,020	13,907	7,135	6,772
10 to 14 years	18,425	9,404	9,021	2,752	1,384	1,368	15,673	8,020	7,653	15,222	7,789	7,432
15 to 19 years	21,365	10,889	10,476	3,030	1,515	1,515	18,335	9,374	8,962	17,874	9,140	8,734
20 to 24 years	22,059	11,203	10,856	2,951	1,458	1,493	19,108	9,745	9,363	18,641	9,519	9,122
25 to 29 years	20,397	10,330	10,067	2,579	1,270	1,309	17,818	9,060	8,759	17,315	8,824	8,491
30 to 34 years	18,092	9,101	8,991	2,092	1,027	1,065	16,000	8,074	7,926	15,525	7,857	7,669
35 to 39 years	14,458	7,240	7,218	1,653	810	844	12,804	6,430	6,374	12,431	6,253	6,179
40 to 44 years	12,082	6,033	6,048	1,445	706	738	10,637	5,327	5,310	10,350	5,186	5,164
45 to 49 years	11,447	5,674	5,773	1,308	639	669	10,139	5,035	5,104	9,906	4,928	4,978
50 to 54 years	11,939	5,845	6,094	1,247	604	643	10,692	5,241	5,451	10,494	5,153	5,342
55 to 59 years	11,772	5,664	6,107	1,112	527	585	10,660	5,138	5,522	10,493	5,060	5,433
60 to 64 years	10,181	4,776	5,404	905	415	491	9,276	4,362	4,914	9,150	4,304	4,846
65 to 69 years	8,677	3,885	4,792	744	324	420	7,934	3,562	4,372	7,832	3,513	4,319
70 to 74 years	6,775	2,845	3,931	554	231	323	6,221	2,614	3,607	6,148	2,577	3,571
75 years and over	10,207	3,584	6,623	783	283	500	9,424	3,300	6,124	9,336	3,260	6,076
NET UNDERCOUNT												
All ages	5,171	3,739	1,432	1,862	1,306	556	3,309	2,433	876	3,426	2,509	916
Under 5 years	408	214	194	258	135	123	150	80	70	99	53	45
5 to 9 years	386	204	181	165	87	78	221	117	104	190	101	89
10 to 14 years	183	88	95	60	31	30	122	57	65	127	60	67
15 to 19 years	197	133	64	23	15	8	174	118	55	193	131	61
20 to 24 years	740	539	201	202	145	57	538	394	144	569	417	152
25 to 29 years	876	624	252	237	175	62	639	450	190	657	461	196
30 to 34 years	531	424	106	188	149	39	343	276	67	369	292	77
35 to 39 years	492	378	114	185	142	42	307	236	72	309	239	71
40 to 44 years	412	325	87	184	135	49	228	190	38	240	195	45
45 to 49 years	358	286	72	158	120	37	200	165	34	213	173	40
50 to 54 years	229	224	5	112	97	15	117	127	-10	134	137	-2
55 to 59 years	156	182	-26	70	58	12	86	124	-38	99	132	-32
60 to 64 years	93	107	-13	31	28	3	62	78	-16	72	84	-12
65 to 69 years	-105	-18	-87	-36	-9	-27	-70	-9	-61	-60	-4	-56
70 to 74 years	-23	-9	-14	-11	-4	-7	-12	-5	-7	-5	-1	-4
75 years and over	238	35	203	35	2	33	203	33	170	219	40	180
PERCENT NET UNDERCOUNT*												
All ages	2.2	3.3	1.2	6.5	9.4	3.8	1.6	2.4	0.8	1.7	2.6	0.9
Under 5 years	2.4	2.5	2.4	9.5	9.8	9.2	1.1	1.1	1.0	0.7	0.8	0.7
5 to 9 years	2.3	2.3	2.2	6.2	6.5	5.9	1.5	1.6	1.5	1.4	1.4	1.3
10 to 14 years	1.0	0.9	1.1	2.2	2.2	2.2	0.8	0.7	0.9	0.8	0.8	0.9
15 to 19 years	0.9	1.2	0.6	0.8	1.0	0.6	0.9	1.3	0.6	1.1	1.4	0.7
20 to 24 years	3.4	4.8	1.8	6.8	9.9	3.8	2.8	4.0	1.5	3.1	4.4	1.7
25 to 29 years	4.3	6.0	2.5	9.2	13.8	4.7	3.6	5.0	2.2	3.8	5.2	2.3
30 to 34 years	2.9	4.7	1.2	9.0	14.5	3.7	2.1	3.4	0.8	2.4	3.7	1.0
35 to 39 years	3.4	5.2	1.6	11.2	17.6	5.0	2.4	3.7	1.1	2.5	3.8	1.1
40 to 44 years	3.4	5.4	1.4	12.8	19.2	6.6	2.1	3.6	0.7	2.3	3.8	0.9
45 to 49 years	3.1	5.0	1.2	12.1	18.8	5.6	2.0	3.3	0.7	2.1	3.5	0.8
50 to 54 years	1.9	3.8	0.1	9.0	16.0	2.4	1.1	2.4	-0.2	1.3	2.7	-
55 to 59 years	1.3	3.2	-0.4	6.3	11.0	2.1	0.8	2.4	-0.7	0.9	2.6	-0.6
60 to 64 years	0.9	2.2	-0.2	3.4	6.8	0.6	0.7	1.8	-0.3	0.8	1.9	-0.2
65 to 69 years	-1.2	-0.5	-1.8	-4.8	-2.8	-6.4	-0.9	-0.2	-1.4	-0.8	-0.1	-1.3
70 to 74 years	-0.3	-0.3	-0.4	-2.0	-1.8	-2.1	-0.2	-0.2	-0.2	-0.1	-	-0.1
75 years and over	2.3	1.0	3.1	4.5	0.7	6.6	2.2	1.0	2.8	2.3	1.2	3.0

- Represents zero or rounds to zero.

*Base of percent is estimated population.

Note: Estimates include an allowance for 5 million undocumented residents in 1980. See text for derivation of estimated population. Estimates compared to census counts classified by modified race.

Table A.70.1. Estimated Population and Amount of Net Undercount From Demographic Analysis for the Legally Resident Population by Age, Sex, and Race: 1970

(Populations in thousands. All figures rounded independently. A minus sign denotes a net overcount)

Population and age	All races			Black			White-and-other races			White		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
ESTIMATED POPULATION												
All ages	208,625	102,369	106,256	24,472	11,985	12,487	184,154	90,384	93,770	181,623	89,131	92,493
Under 5 years	17,777	9,086	8,691	2,699	1,360	1,339	15,077	7,726	7,351	14,779	7,574	7,205
5 to 9 years	20,564	10,491	10,073	2,952	1,484	1,468	17,612	9,007	8,605	17,301	8,849	8,452
10 to 14 years	21,046	10,738	10,308	2,908	1,462	1,446	18,138	9,276	8,862	17,857	9,133	8,724
15 to 19 years	19,246	9,765	9,481	2,521	1,257	1,264	16,726	8,508	8,218	16,489	8,387	8,102
20 to 24 years	16,671	8,156	8,514	1,987	958	1,029	14,683	7,198	7,485	14,467	7,094	7,373
25 to 29 years	13,897	6,948	6,949	1,624	800	824	12,273	6,148	6,124	12,076	6,057	6,020
30 to 34 years	11,808	5,898	5,910	1,449	714	735	10,359	5,184	5,176	10,188	5,104	5,084
35 to 39 years	11,495	5,723	5,772	1,351	668	683	10,144	5,056	5,089	9,982	4,984	4,999
40 to 44 years	12,383	6,143	6,240	1,342	664	678	11,041	5,479	5,562	10,886	5,410	5,477
45 to 49 years	12,608	6,214	6,394	1,254	616	638	11,354	5,598	5,756	11,223	5,534	5,689
50 to 54 years	11,397	5,574	5,824	1,077	520	557	10,320	5,054	5,267	10,223	5,005	5,218
55 to 59 years	10,343	4,964	5,379	958	451	507	9,386	4,513	4,873	9,305	4,470	4,835
60 to 64 years	8,861	4,143	4,719	793	367	426	8,069	3,775	4,293	8,002	3,737	4,265
65 to 69 years	7,092	3,172	3,920	605	272	333	6,487	2,900	3,587	6,437	2,872	3,566
70 to 74 years	5,560	2,343	3,217	430	187	243	5,130	2,156	2,974	5,095	2,138	2,957
75 years and over	7,876	3,011	4,865	521	205	316	7,355	2,806	4,549	7,312	2,785	4,527
NET UNDERCOUNT												
All ages	5,323	3,410	1,913	1,883	1,232	650	3,440	2,177	1,263	3,468	2,196	1,272
Under 5 years	610	334	276	265	140	125	345	194	151	311	175	136
5 to 9 years	590	313	277	202	105	97	388	208	180	356	191	165
10 to 14 years	236	137	99	95	54	41	142	83	58	129	75	54
15 to 19 years	155	120	35	95	54	41	60	66	-6	70	69	1
20 to 24 years	278	225	53	171	117	54	107	108	-	131	121	10
25 to 29 years	407	319	88	195	142	53	212	177	35	223	185	38
30 to 34 years	369	298	71	195	146	49	174	152	22	187	161	26
35 to 39 years	380	307	73	154	127	28	226	180	45	232	185	47
40 to 44 years	391	319	72	142	120	23	249	199	50	250	201	49
45 to 49 years	480	357	123	130	95	35	350	262	88	352	263	89
50 to 54 years	283	221	62	86	61	25	197	160	37	200	162	39
55 to 59 years	361	194	167	83	46	37	278	148	130	281	150	131
60 to 64 years	236	112	124	58	33	26	177	79	98	181	81	99
65 to 69 years	94	47	47	-22	-5	-17	116	52	64	125	57	68
70 to 74 years	111	26	86	14	3	11	97	23	74	103	26	78
75 years and over	343	84	260	20	-3	23	323	86	237	337	94	243
PERCENT NET UNDERCOUNT*												
All ages	2.6	3.3	1.8	7.7	10.3	5.2	1.9	2.4	1.3	1.9	2.5	1.4
Under 5 years	3.4	3.7	3.2	9.8	10.3	9.4	2.3	2.5	2.1	2.1	2.3	1.9
5 to 9 years	2.9	3.0	2.7	6.8	7.1	6.6	2.2	2.3	2.1	2.1	2.2	2.0
10 to 14 years	1.1	1.3	1.0	3.3	3.7	2.8	0.8	0.9	0.7	0.7	0.8	0.6
15 to 19 years	0.8	1.2	0.4	3.8	4.3	3.2	0.4	0.8	-0.1	0.4	0.8	-
20 to 24 years	1.7	2.8	0.6	8.6	12.2	5.2	0.7	1.5	-	0.9	1.7	0.1
25 to 29 years	2.9	4.6	1.3	12.0	17.7	6.4	1.7	2.9	0.6	1.8	3.1	0.6
30 to 34 years	3.1	5.0	1.2	13.5	20.4	6.7	1.7	2.9	0.4	1.8	3.2	0.5
35 to 39 years	3.3	5.4	1.3	11.4	19.0	4.0	2.2	3.6	0.9	2.3	3.7	0.9
40 to 44 years	3.2	5.2	1.2	10.6	18.0	3.4	2.3	3.6	0.9	2.3	3.7	0.9
45 to 49 years	3.8	5.7	1.9	10.4	15.4	5.5	3.1	4.7	1.5	3.1	4.8	1.6
50 to 54 years	2.5	4.0	1.1	8.0	11.7	4.6	1.9	3.2	0.7	2.0	3.2	0.7
55 to 59 years	3.5	3.9	3.1	8.7	10.2	7.3	3.0	3.3	2.7	3.0	3.3	2.7
60 to 64 years	2.7	2.7	2.6	7.4	8.9	6.1	2.2	2.1	2.3	2.3	2.2	2.3
65 to 69 years	1.3	1.5	1.2	-3.7	-2.0	-5.0	1.8	1.8	1.8	1.9	2.0	1.9
70 to 74 years	2.0	1.1	2.7	3.3	1.6	4.6	1.9	1.1	2.5	2.0	1.2	2.6
75 years and over	4.4	2.8	5.3	3.9	-1.2	7.2	4.4	3.1	5.2	4.6	3.4	5.4

- Represents zero or rounds to zero.

* Base of percent is estimated population.

Note: Estimates include no allowance for undocumented immigration. See text for derivation of estimated population.

Table A.70.2. Estimated Population and Amount and Percent of Net Undercount From Demographic Analysis for the Total Resident Population (Based on 2.06 Million Undocumented Residents Counted in 1980) by Age, Sex, and Race: 1970

(Populations in thousands. All figures rounded independently. A minus sign denotes a net overcount)

Population and age	All races			Black			White-and-other races			White		
	80th sexes	Male	Female	80th sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
ESTIMATED POPULATION												
All ages	209,165	102,642	106,524	24,531	12,012	12,519	184,634	90,629	94,005	182,045	89,344	92,701
Under 5 years	17,803	9,099	8,704	2,702	1,361	1,340	15,101	7,738	7,363	14,800	7,584	7,216
5 to 9 years	20,609	10,515	10,094	2,958	1,487	1,471	17,652	9,029	8,623	17,338	8,869	8,469
10 to 14 years	21,102	10,766	10,336	2,913	1,465	1,449	18,189	9,302	8,887	17,905	9,158	8,747
15 to 19 years	19,327	9,806	9,521	2,528	1,260	1,268	16,799	8,545	8,253	16,556	8,421	8,135
20 to 24 years	16,783	8,215	8,568	1,997	963	1,034	14,785	7,252	7,533	14,556	7,141	7,415
25 to 29 years	13,998	7,003	6,995	1,635	805	830	12,363	6,198	6,166	12,152	6,098	6,054
30 to 34 years	11,868	5,929	5,939	1,456	718	739	10,412	5,212	5,200	10,233	5,127	5,106
35 to 39 years	11,522	5,734	5,788	1,355	670	686	10,167	5,065	5,102	10,001	4,991	5,010
40 to 44 years	12,395	6,147	6,247	1,344	665	679	11,051	5,483	5,568	10,894	5,413	5,482
45 to 49 years	12,616	6,217	6,398	1,255	616	639	11,360	5,601	5,759	11,228	5,536	5,692
50 to 54 years	11,401	5,575	5,826	1,078	520	558	10,323	5,055	5,268	10,225	5,006	5,219
55 to 59 years	10,346	4,965	5,381	958	451	507	9,388	4,514	4,874	9,306	4,470	4,836
60 to 64 years	8,863	4,143	4,720	793	367	426	8,070	3,776	4,294	8,003	3,738	4,265
65 to 69 years	7,095	3,172	3,923	606	272	334	6,489	2,900	3,589	6,440	2,872	3,568
70 to 74 years	5,562	2,343	3,219	431	187	244	5,131	2,156	2,975	5,096	2,138	2,958
75 years and over	7,877	3,012	4,866	521	205	316	7,356	2,807	4,549	7,313	2,785	4,528
NET UNDERCOUNT												
All ages	5,863	3,682	2,181	1,942	1,260	682	3,921	2,423	1,498	3,890	2,410	1,480
Under 5 years	636	347	289	267	141	126	369	206	163	332	186	146
5 to 9 years	635	338	298	207	108	99	428	230	198	393	211	182
10 to 14 years	292	165	127	100	56	44	192	109	84	177	99	78
15 to 19 years	235	160	75	102	57	45	133	103	30	137	103	34
20 to 24 years	390	283	107	181	122	59	209	162	48	220	168	51
25 to 29 years	508	373	134	205	147	58	303	227	76	298	226	72
30 to 34 years	428	329	99	202	149	53	226	180	46	231	184	47
35 to 39 years	407	318	89	158	129	30	248	189	59	250	192	58
40 to 44 years	403	324	80	145	121	24	258	203	55	259	204	54
45 to 49 years	488	360	128	131	96	36	356	264	92	357	265	92
50 to 54 years	286	222	64	87	61	26	199	161	38	202	163	40
55 to 59 years	364	195	169	84	46	38	280	148	131	282	150	132
60 to 64 years	237	112	125	59	33	26	179	79	99	182	82	100
65 to 69 years	97	47	49	-22	-5	-17	118	52	66	127	57	70
70 to 74 years	113	26	87	14	3	11	99	23	75	104	26	79
75 years and over	344	84	261	20	-3	23	324	87	238	338	94	244
PERCENT NET UNDERCOUNT*												
All ages	2.8	3.6	2.0	7.9	10.5	5.5	2.1	2.7	1.6	2.1	2.7	1.6
Under 5 years	3.6	3.8	3.3	9.9	10.3	9.4	2.4	2.7	2.2	2.2	2.5	2.0
5 to 9 years	3.1	3.2	2.9	7.0	7.3	6.8	2.4	2.5	2.3	2.3	2.4	2.1
10 to 14 years	1.4	1.5	1.2	3.4	3.8	3.0	1.1	1.2	0.9	1.0	1.1	0.9
15 to 19 years	1.2	1.6	0.8	4.0	4.5	3.5	0.8	1.2	0.4	0.8	1.2	0.4
20 to 24 years	2.3	3.4	1.2	9.0	12.6	5.7	1.4	2.2	0.6	1.5	2.4	0.7
25 to 29 years	3.6	5.3	1.9	12.6	18.2	7.0	2.4	3.7	1.2	2.5	3.7	1.2
30 to 34 years	3.6	5.5	1.7	13.9	20.8	7.2	2.2	3.4	0.9	2.3	3.6	0.9
35 to 39 years	3.5	5.5	1.5	11.7	19.2	4.4	2.4	3.7	1.2	2.5	3.8	1.2
40 to 44 years	3.3	5.3	1.3	10.8	18.1	3.6	2.3	3.7	1.0	2.4	3.8	1.0
45 to 49 years	3.9	5.8	2.0	10.5	15.5	5.6	3.1	4.7	1.6	3.2	4.8	1.6
50 to 54 years	2.5	4.0	1.1	8.1	11.8	4.7	1.9	3.2	0.7	2.0	3.2	0.8
55 to 59 years	3.5	3.9	3.1	8.8	10.2	7.5	3.0	3.3	2.7	3.0	3.4	2.7
60 to 64 years	2.7	2.7	2.7	7.4	8.9	6.1	2.2	2.1	2.3	2.3	2.2	2.3
65 to 69 years	1.4	1.5	1.3	-3.6	-1.9	-5.0	1.8	1.8	1.8	2.0	2.0	2.0
70 to 74 years	2.0	1.1	2.7	3.3	1.6	4.6	1.9	1.1	2.5	2.0	1.2	2.7
75 years and over	4.4	2.8	5.4	3.9	-1.2	7.2	4.4	3.1	5.2	4.6	3.4	5.4

*Base of percent is estimated population.

Note: Estimates include an allowance for undocumented immigration corresponding to the 2.06 million undocumented residents estimated to have been counted in the 1980 census. See text for derivation of estimated population.

Table A.70.3. Estimated Population and Amount and Percent of Net Undercount From Demographic Analysis for the Total Resident Population (Based on 3 Million Undocumented Residents in 1980) by Age, Sex, and Race: 1970

(Populations in thousands. All figures rounded independently. A minus sign denotes a net overcount)

Population and age	All races			Black			White-and-other races			White		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
ESTIMATED POPULATION												
All ages	209,413	102,767	106,646	24,558	12,025	12,533	184,855	90,742	94,113	182,239	89,443	92,796
Under 5 years	17,815	9,105	8,710	2,703	1,362	1,341	15,112	7,743	7,369	14,810	7,589	7,221
5 to 9 years	20,630	10,526	10,104	2,960	1,488	1,472	17,670	9,038	8,632	17,354	8,878	8,476
10 to 14 years	21,128	10,779	10,349	2,916	1,466	1,450	18,212	9,313	8,899	17,927	9,169	8,758
15 to 19 years	19,364	9,824	9,539	2,531	1,262	1,270	16,832	8,562	8,270	16,587	8,437	8,150
20 to 24 years	16,834	8,242	8,592	2,002	965	1,037	14,832	7,277	7,555	14,597	7,163	7,434
25 to 29 years	14,044	7,028	7,017	1,640	807	832	12,405	6,220	6,184	12,186	6,116	6,070
30 to 34 years	11,895	5,944	5,951	1,460	719	740	10,436	5,224	5,211	10,253	5,137	5,116
35 to 39 years	11,534	5,739	5,795	1,357	670	687	10,177	5,069	5,108	10,009	4,994	5,016
40 to 44 years	12,400	6,149	6,251	1,345	665	680	11,055	5,484	5,571	10,898	5,414	5,484
45 to 49 years	12,619	6,219	6,401	1,256	617	640	11,363	5,602	5,761	11,230	5,537	5,694
50 to 54 years	11,402	5,576	5,827	1,078	520	558	10,324	5,055	5,269	10,226	5,006	5,220
55 to 59 years	10,347	4,965	5,382	959	451	507	9,389	4,514	4,874	9,307	4,471	4,836
60 to 64 years	8,864	4,143	4,721	794	367	426	8,070	3,776	4,294	8,003	3,738	4,266
65 to 69 years	7,096	3,172	3,924	606	272	334	6,490	2,900	3,590	6,441	2,872	3,569
70 to 74 years	5,562	2,343	3,219	431	187	244	5,132	2,156	2,975	5,097	2,138	2,959
75 years and over	7,878	3,012	4,866	521	205	316	7,356	2,807	4,550	7,314	2,785	4,528
NET UNDERCOUNT												
All ages	6,111	3,807	2,303	1,969	1,272	697	4,142	2,536	1,606	4,084	2,508	1,576
Under 5 years	648	353	295	268	141	127	380	212	168	342	191	151
5 to 9 years	656	349	307	210	109	101	446	239	207	409	220	190
10 to 14 years	318	178	140	103	57	45	216	121	95	199	110	88
15 to 19 years	272	179	93	105	59	47	167	120	46	168	119	49
20 to 24 years	441	310	131	185	124	61	256	186	70	261	190	71
25 to 29 years	554	398	156	210	149	61	344	249	95	333	245	88
30 to 34 years	456	343	112	205	151	55	250	193	58	252	194	57
35 to 39 years	419	323	96	160	129	31	258	193	65	259	195	64
40 to 44 years	409	326	83	146	121	25	263	205	58	262	205	57
45 to 49 years	491	361	130	132	96	36	359	266	93	359	266	93
50 to 54 years	288	223	65	88	61	26	200	161	39	203	163	40
55 to 59 years	365	195	170	84	46	38	281	149	132	283	151	132
60 to 64 years	238	112	126	59	33	26	179	80	100	182	82	100
65 to 69 years	98	47	51	-22	-5	-16	120	53	67	129	57	71
70 to 74 years	113	26	87	14	3	11	99	23	76	105	26	79
75 years and over	345	84	261	20	-3	23	325	87	238	338	95	244
PERCENT NET UNDERCOUNT*												
All ages	2.9	3.7	2.2	8.0	10.6	5.6	2.2	2.8	1.7	2.2	2.8	1.7
Under 5 years	3.6	3.9	3.4	9.9	10.4	9.5	2.5	2.7	2.3	2.3	2.5	2.1
5 to 9 years	3.2	3.3	3.0	7.1	7.3	6.8	2.5	2.6	2.4	2.4	2.5	2.2
10 to 14 years	1.5	1.7	1.4	3.5	3.9	3.1	1.2	1.3	1.1	1.1	1.2	1.0
15 to 19 years	1.4	1.8	1.0	4.2	4.6	3.7	1.0	1.4	0.6	1.0	1.4	0.6
20 to 24 years	2.6	3.8	1.5	9.3	12.8	5.9	1.7	2.6	0.9	1.8	2.7	0.9
25 to 29 years	3.9	5.7	2.2	12.8	18.5	7.3	2.8	4.0	1.5	2.7	4.0	1.5
30 to 34 years	3.8	5.8	1.9	14.1	20.9	7.4	2.4	3.7	1.1	2.5	3.8	1.1
35 to 39 years	3.6	5.6	1.7	11.8	19.3	4.5	2.5	3.8	1.3	2.6	3.9	1.3
40 to 44 years	3.3	5.3	1.3	10.9	18.2	3.7	2.4	3.7	1.0	2.4	3.8	1.0
45 to 49 years	3.9	5.8	2.0	10.5	15.6	5.7	3.2	4.7	1.6	3.2	4.8	1.6
50 to 54 years	2.5	4.0	1.1	8.1	11.8	4.7	1.9	3.2	0.7	2.0	3.3	0.8
55 to 59 years	3.5	3.9	3.2	8.8	10.2	7.5	3.0	3.3	2.7	3.0	3.4	2.7
60 to 64 years	2.7	2.7	2.7	7.4	8.9	6.2	2.2	2.1	2.3	2.3	2.2	2.4
65 to 69 years	1.4	1.5	1.3	-3.6	-1.9	-4.9	1.8	1.8	1.9	2.0	2.0	2.0
70 to 74 years	2.0	1.1	2.7	3.3	1.6	4.7	1.9	1.1	2.6	2.1	1.2	2.7
75 years and over	4.4	2.8	5.4	3.9	-1.2	7.2	4.4	3.1	5.2	4.6	3.4	5.4

*Base of percent is estimated population.

Note: Estimates include an allowance for undocumented immigration corresponding to 3 million undocumented residents in 1980. See text for derivation of estimated population.

Table A.70.4. Estimated Population and Amount and Percent of Net Undercount From Demographic Analysis for the Total Resident Population (Based on 4 Million Undocumented Residents in 1980) by Age, Sex, and Race: 1970

(Populations in thousands. All figures rounded independently. A minus sign denotes a net overcount)

Population and age	All races			Black			White-and-other races			White		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
ESTIMATED POPULATION												
All ages	209,675	102,899	106,776	24,587	12,038	12,549	185,089	90,861	94,227	182,444	89,547	92,897
Under 5 years	17,827	9,111	8,716	2,704	1,362	1,341	15,124	7,749	7,375	14,820	7,594	7,226
5 to 9 years	20,652	10,538	10,114	2,963	1,489	1,473	17,689	9,049	8,640	17,372	8,888	8,484
10 to 14 years	21,155	10,793	10,362	2,918	1,467	1,451	18,237	9,326	8,911	17,950	9,181	8,769
15 to 19 years	19,403	9,844	9,559	2,535	1,263	1,272	16,868	8,581	8,287	16,619	8,453	8,166
20 to 24 years	16,888	8,271	8,618	2,007	968	1,039	14,882	7,303	7,579	14,640	7,186	7,454
25 to 29 years	14,094	7,054	7,039	1,645	810	835	12,449	6,244	6,204	12,223	6,136	6,087
30 to 34 years	11,924	5,959	5,965	1,463	721	742	10,461	5,238	5,223	10,275	5,148	5,127
35 to 39 years	11,547	5,744	5,803	1,359	671	688	10,188	5,073	5,115	10,018	4,997	5,021
40 to 44 years	12,406	6,152	6,254	1,346	666	681	11,060	5,486	5,574	10,902	5,415	5,487
45 to 49 years	12,623	6,220	6,403	1,257	617	640	11,366	5,603	5,763	11,233	5,538	5,695
50 to 54 years	11,404	5,576	5,828	1,079	520	558	10,325	5,056	5,270	10,227	5,007	5,220
55 to 59 years	10,349	4,966	5,383	959	451	508	9,389	4,514	4,875	9,308	4,471	4,837
60 to 64 years	8,865	4,144	4,721	794	367	426	8,071	3,776	4,295	8,004	3,738	4,266
65 to 69 years	7,098	3,173	3,925	606	272	334	6,492	2,900	3,591	6,442	2,872	3,570
70 to 74 years	5,563	2,343	3,220	431	187	244	5,132	2,156	2,976	5,097	2,138	2,959
75 years and over	7,878	3,012	4,866	521	205	316	7,357	2,807	4,550	7,314	2,785	4,529
NET UNDERCOUNT												
All ages	6,373	3,940	2,433	1,998	1,285	713	4,375	2,655	1,721	4,289	2,612	1,677
Under 5 years	660	359	301	269	142	127	391	217	174	352	196	156
5 to 9 years	678	360	318	212	111	102	466	250	216	427	229	198
10 to 14 years	346	192	154	105	59	47	241	133	107	222	122	100
15 to 19 years	311	199	112	109	60	49	202	139	64	201	136	65
20 to 24 years	496	339	157	190	126	64	306	213	93	304	213	91
25 to 29 years	603	425	178	215	152	64	388	273	115	370	265	105
30 to 34 years	485	359	126	209	152	57	276	206	69	273	205	68
35 to 39 years	432	328	104	163	130	32	269	198	72	268	198	69
40 to 44 years	414	328	87	147	122	26	267	206	61	266	207	59
45 to 49 years	495	363	132	133	96	37	362	267	95	362	267	95
50 to 54 years	290	223	66	88	61	27	202	162	40	204	164	41
55 to 59 years	366	195	171	85	46	38	281	149	132	283	151	133
60 to 64 years	239	112	127	59	33	27	180	80	100	183	82	101
65 to 69 years	99	48	52	-21	-5	-16	121	53	68	130	57	72
70 to 74 years	114	26	88	14	3	11	100	23	76	106	26	80
75 years and over	345	84	261	20	-3	23	325	87	238	339	95	244
PERCENT NET UNDERCOUNT*												
All ages	3.0	3.8	2.3	8.1	10.7	5.7	2.4	2.9	1.8	2.4	2.9	1.8
Under 5 years	3.7	3.9	3.5	10.0	10.4	9.5	2.6	2.8	2.4	2.4	2.6	2.2
5 to 9 years	3.3	3.4	3.1	7.2	7.4	6.9	2.6	2.8	2.5	2.5	2.6	2.3
10 to 14 years	1.6	1.8	1.5	3.6	4.0	3.2	1.3	1.4	1.2	1.2	1.3	1.1
15 to 19 years	1.6	2.0	1.2	4.3	4.8	3.8	1.2	1.6	0.8	1.2	1.6	0.8
20 to 24 years	2.9	4.1	1.8	9.5	13.0	6.1	2.1	2.9	1.2	2.1	3.0	1.2
25 to 29 years	4.3	6.0	2.5	13.1	18.7	7.6	3.1	4.4	1.8	3.0	4.3	1.7
30 to 34 years	4.1	6.0	2.1	14.3	21.1	7.6	2.6	3.9	1.3	2.7	4.0	1.3
35 to 39 years	3.7	5.7	1.8	12.0	19.4	4.7	2.6	3.9	1.4	2.7	4.0	1.4
40 to 44 years	3.3	5.3	1.4	10.9	18.3	3.8	2.4	3.8	1.1	2.4	3.8	1.1
45 to 49 years	3.9	5.8	2.1	10.6	15.6	5.7	3.2	4.8	1.7	3.2	4.8	1.7
50 to 54 years	2.5	4.0	1.1	8.2	11.8	4.8	2.0	3.2	0.8	2.0	3.3	0.8
55 to 59 years	3.5	3.9	3.2	8.8	10.3	7.6	3.0	3.3	2.7	3.0	3.4	2.7
60 to 64 years	2.7	2.7	2.7	7.5	8.9	6.2	2.2	2.1	2.3	2.3	2.2	2.4
65 to 69 years	1.4	1.5	1.3	-3.5	-1.9	-4.9	1.9	1.8	1.9	2.0	2.0	2.0
70 to 74 years	2.1	1.1	2.7	3.3	1.6	4.7	1.9	1.1	2.6	2.1	1.2	2.7
75 years and over	4.4	2.8	5.4	3.9	-1.2	7.3	4.4	3.1	5.2	4.6	3.4	5.4

*Base of percent is estimated population.

Note: Estimates include an allowance for undocumented immigration corresponding to 4 million undocumented residents in 1980. See text for derivation of estimated population.

Table A.70.5. Estimated Population and Amount and Percent of Net Undercount From Demographic Analysis for the Total Resident Population (Based on 5 Million Undocumented Residents in 1980) by Age, Sex, and Race: 1970

(Populations in thousands. All figures rounded independently. A minus sign denotes a net overcount)

Population and age	All races			Black			White-and-other races			White		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
ESTIMATED POPULATION												
All ages	209,938	103,032	106,906	24,615	12,051	12,564	185,323	90,981	94,342	182,649	89,651	92,998
Under 5 years	17,840	9,118	8,722	2,705	1,363	1,342	15,135	7,755	7,380	14,830	7,599	7,231
5 to 9 years	20,674	10,550	10,124	2,965	1,491	1,475	17,709	9,059	8,649	17,390	8,897	8,492
10 to 14 years	21,183	10,807	10,376	2,921	1,468	1,453	18,262	9,338	8,923	17,973	9,192	8,781
15 to 19 years	19,442	9,863	9,578	2,538	1,265	1,273	16,903	8,599	8,305	16,652	8,470	8,182
20 to 24 years	16,943	8,299	8,644	2,011	970	1,042	14,931	7,329	7,602	14,683	7,209	7,475
25 to 29 years	14,143	7,081	7,062	1,650	813	838	12,493	6,268	6,224	12,260	6,156	6,104
30 to 34 years	11,953	5,974	5,979	1,467	723	744	10,486	5,252	5,235	10,297	5,159	5,138
35 to 39 years	11,560	5,750	5,811	1,362	672	689	10,199	5,077	5,121	10,027	5,000	5,027
40 to 44 years	12,412	6,154	6,258	1,348	666	681	11,064	5,488	5,577	10,906	5,417	5,489
45 to 49 years	12,627	6,222	6,405	1,258	617	641	11,369	5,604	5,764	11,235	5,539	5,696
50 to 54 years	11,406	5,577	5,829	1,079	521	558	10,327	5,056	5,270	10,228	5,007	5,221
55 to 59 years	10,350	4,966	5,383	959	452	508	9,390	4,515	4,876	9,308	4,471	4,837
60 to 64 years	8,866	4,144	4,722	794	368	427	8,072	3,776	4,295	8,004	3,738	4,266
65 to 69 years	7,099	3,173	3,926	606	272	334	6,493	2,901	3,592	6,443	2,872	3,570
70 to 74 years	5,564	2,343	3,220	431	187	244	5,133	2,156	2,977	5,098	2,138	2,960
75 years and over	7,879	3,012	4,867	521	205	316	7,357	2,807	4,550	7,314	2,785	4,529
NET UNDERCOUNT												
All ages	6,636	4,073	2,563	2,027	1,298	728	4,609	2,774	1,835	4,494	2,716	1,778
Under 5 years	673	365	308	270	142	128	403	223	180	363	201	162
5 to 9 years	700	372	328	215	112	103	485	260	225	445	239	206
10 to 14 years	373	206	168	108	60	48	265	146	120	245	134	111
15 to 19 years	350	218	132	112	62	51	238	157	81	233	153	81
20 to 24 years	550	367	183	195	129	66	355	239	116	347	236	111
25 to 29 years	653	452	201	220	154	66	432	297	135	407	285	122
30 to 34 years	513	374	140	212	154	58	301	220	81	295	216	79
35 to 39 years	445	333	112	165	131	33	280	202	78	277	201	75
40 to 44 years	420	330	90	148	122	26	272	208	64	270	208	62
45 to 49 years	499	365	134	134	97	37	365	268	97	364	268	96
50 to 54 years	291	224	67	88	62	27	203	162	40	205	164	41
55 to 59 years	367	196	171	85	46	39	282	150	133	284	151	133
60 to 64 years	240	113	127	60	33	27	181	80	101	183	82	101
65 to 69 years	101	48	53	-21	-5	-16	122	53	69	131	58	73
70 to 74 years	115	26	89	14	3	11	100	23	77	106	26	80
75 years and over	346	84	262	20	-2	23	325	87	239	339	95	245
PERCENT NET UNDERCOUNT*												
All ages	3.2	4.0	2.4	8.2	10.8	5.8	2.5	3.0	1.9	2.5	3.0	1.9
Under 5 years	3.8	4.0	3.5	10.0	10.4	9.5	2.7	2.9	2.4	2.4	2.6	2.2
5 to 9 years	3.4	3.5	3.2	7.2	7.5	7.0	2.7	2.9	2.6	2.6	2.7	2.4
10 to 14 years	1.8	1.9	1.6	3.7	4.1	3.3	1.5	1.6	1.3	1.4	1.5	1.3
15 to 19 years	1.8	2.2	1.4	4.4	4.9	4.0	1.4	1.8	1.0	1.4	1.8	1.0
20 to 24 years	3.2	4.4	2.1	9.7	13.3	6.4	2.4	3.3	1.5	2.4	3.3	1.5
25 to 29 years	4.6	6.4	2.8	13.4	19.0	7.9	3.5	4.7	2.2	3.3	4.6	2.0
30 to 34 years	4.3	6.3	2.3	14.5	21.3	7.9	2.9	4.2	1.6	2.9	4.2	1.5
35 to 39 years	3.8	5.8	1.9	12.1	19.5	4.8	2.7	4.0	1.5	2.8	4.0	1.5
40 to 44 years	3.4	5.4	1.4	11.0	18.3	3.9	2.5	3.8	1.1	2.5	3.8	1.1
45 to 49 years	3.9	5.9	2.1	10.6	15.6	5.8	3.2	4.8	1.7	3.2	4.8	1.7
50 to 54 years	2.6	4.0	1.2	8.2	11.8	4.8	2.0	3.2	0.8	2.0	3.3	0.8
55 to 59 years	3.5	3.9	3.2	8.9	10.3	7.6	3.0	3.3	2.7	3.1	3.4	2.7
60 to 64 years	2.7	2.7	2.7	7.5	8.9	6.3	2.2	2.1	2.3	2.3	2.2	2.4
65 to 69 years	1.4	1.5	1.3	-3.5	-1.8	-4.8	1.9	1.8	1.9	2.0	2.0	2.0
70 to 74 years	2.1	1.1	2.7	3.4	1.6	4.7	2.0	1.1	2.6	2.1	1.2	2.7
75 years and over	4.4	2.8	5.4	3.9	-1.2	7.3	4.4	3.1	5.2	4.6	3.4	5.4

*Base of percent is estimated population.

Note: Estimates include an allowance for undocumented immigration corresponding to 5 million undocumented residents in 1980. See text for derivation of estimated population.

Table A.60.1. Estimated Population and Amount and Percent of Net Undercount From Demographic Analysis for the Legally Resident Population by Age, Sex, and Race: 1960

(Populations in thousands. All figures rounded independently. A minus sign denotes a net overcount)

Population and age	All races			Black			White-and-other races			White		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
ESTIMATED POPULATION												
All ages	185,427	91,798	93,629	20,583	10,175	10,408	164,845	81,623	83,221	163,156	80,753	82,403
Under 5 years	20,822	10,632	10,189	2,913	1,467	1,447	17,908	9,166	8,743	17,654	9,036	8,617
5 to 9 years	19,134	9,768	9,365	2,527	1,268	1,259	16,607	8,501	8,106	16,397	8,394	8,003
10 to 14 years	17,121	8,743	8,378	2,060	1,035	1,025	15,061	7,708	7,353	14,892	7,623	7,270
15 to 19 years	13,670	6,912	6,757	1,643	821	822	12,027	6,091	5,936	11,887	6,019	5,868
20 to 24 years	11,432	5,677	5,756	1,461	724	737	9,971	4,953	5,019	9,845	4,889	4,956
25 to 29 years	11,408	5,709	5,699	1,384	691	693	10,024	5,018	5,007	9,899	4,959	4,939
30 to 34 years	12,440	6,201	6,239	1,398	699	700	11,042	5,502	5,540	10,911	5,442	5,469
35 to 39 years	12,894	6,403	6,491	1,339	665	674	11,555	5,738	5,816	11,436	5,678	5,758
40 to 44 years	11,950	5,929	6,021	1,187	584	603	10,763	5,345	5,417	10,671	5,298	5,372
45 to 49 years	11,237	5,552	5,686	1,105	537	568	10,132	5,015	5,118	10,053	4,971	5,083
50 to 54 years	10,105	4,965	5,140	969	469	500	9,136	4,497	4,640	9,068	4,455	4,613
55 to 59 years	8,675	4,187	4,488	818	389	429	7,857	3,798	4,059	7,803	3,765	4,037
60 to 64 years	7,560	3,560	4,000	660	314	346	6,900	3,246	3,654	6,857	3,222	3,635
65 to 69 years	6,443	2,984	3,459	477	226	251	5,966	2,758	3,208	5,934	2,741	3,193
70 to 74 years	4,756	2,146	2,609	303	138	165	4,452	2,008	2,444	4,430	1,994	2,435
75 years and over	5,782	2,429	3,353	338	149	190	5,444	2,280	3,163	5,420	2,266	3,154
NET UNDERCOUNT												
All ages	6,104	3,467	2,638	1,710	1,061	649	4,394	2,406	1,988	4,324	2,386	1,938
Under 5 years	501	303	198	182	104	79	318	199	119	295	187	108
5 to 9 years	442	264	178	122	67	55	320	197	123	309	192	117
10 to 14 years	348	219	129	89	51	38	259	168	91	254	166	88
15 to 19 years	450	279	172	153	87	66	297	191	106	279	182	96
20 to 24 years	632	404	227	242	153	88	390	251	139	374	243	131
25 to 29 years	539	375	163	195	139	56	343	236	107	343	237	106
30 to 34 years	491	355	136	166	131	35	325	224	101	322	224	98
35 to 39 years	413	324	89	115	92	23	298	232	66	295	231	64
40 to 44 years	349	253	96	97	71	25	253	182	71	248	181	66
45 to 49 years	358	194	164	86	52	34	271	142	130	268	142	126
50 to 54 years	499	231	268	123	62	60	376	168	208	375	169	205
55 to 59 years	245	60	185	86	33	53	158	26	132	176	37	140
60 to 64 years	418	151	267	111	52	59	307	99	208	307	100	206
65 to 69 years	185	53	132	-11	-4	-8	196	57	139	195	57	138
70 to 74 years	17	-39	56	-21	-14	-7	38	-25	63	39	-24	62
75 years and over	219	42	177	-25	-16	-9	245	59	186	247	60	186
PERCENT NET UNDERCOUNT*												
All ages	3.3	3.8	2.8	8.3	10.4	6.2	2.7	2.9	2.4	2.7	3.0	2.4
Under 5 years	2.4	2.8	1.9	6.3	7.1	5.4	1.8	2.2	1.4	1.7	2.1	1.3
5 to 9 years	2.3	2.7	1.9	4.8	5.3	4.3	1.9	2.3	1.5	1.9	2.3	1.5
10 to 14 years	2.0	2.5	1.5	4.3	4.9	3.7	1.7	2.2	1.2	1.7	2.2	1.2
15 to 19 years	3.3	4.0	2.5	9.3	10.6	8.1	2.5	3.1	1.8	2.3	3.0	1.6
20 to 24 years	5.5	7.1	3.9	16.5	21.2	12.0	3.9	5.1	2.8	3.8	5.0	2.6
25 to 29 years	4.7	6.6	2.9	14.1	20.2	8.1	3.4	4.7	2.1	3.5	4.8	2.1
30 to 34 years	3.9	5.7	2.2	11.9	18.8	5.0	2.9	4.1	1.8	3.0	4.1	1.8
35 to 39 years	3.2	5.1	1.4	8.6	13.8	3.4	2.6	4.0	1.1	2.6	4.1	1.1
40 to 44 years	2.9	4.3	1.6	8.1	12.2	4.2	2.3	3.4	1.3	2.3	3.4	1.3
45 to 49 years	3.2	3.5	2.9	7.8	9.7	6.0	2.7	2.8	2.5	2.7	2.9	2.5
50 to 54 years	4.9	4.6	5.2	12.7	13.3	12.1	4.1	3.7	4.5	4.1	3.8	4.4
55 to 59 years	2.8	1.4	4.1	10.6	8.6	12.4	2.0	0.7	3.3	2.3	1.0	3.5
60 to 64 years	5.5	4.2	6.7	16.8	16.5	17.1	4.4	3.0	5.7	4.5	3.1	5.7
65 to 69 years	2.9	1.8	3.8	-2.3	-1.6	-3.0	3.3	2.1	4.3	3.3	2.1	4.3
70 to 74 years	0.3	-1.8	2.1	-6.9	-10.1	-4.3	0.8	-1.3	2.6	0.9	-1.2	2.6
75 years and over	3.8	1.7	5.3	-7.4	-11.0	-4.6	4.5	2.6	5.9	4.5	2.7	5.9

*Base of percent is estimated population.

Note: See text for derivation of estimated population.

Table A.60.2. Estimated Population and Amount and Percent of Net Undercount From Demographic Analysis for the Total Resident Population (Based on 3 Million Undocumented Residents in 1980) by Age, Sex, and Race: 1960

(Populations in thousands. All figures rounded independently. A minus sign denotes a net overcount)

Population and age	All races			Black			White-and-other races			White		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
ESTIMATED POPULATION												
All ages	185,480	91,822	93,658	20,583	10,175	10,408	164,897	81,647	83,250	163,209	80,777	82,431
Under 5 years	20,827	10,636	10,192	2,913	1,467	1,447	17,914	9,169	8,745	17,659	9,040	8,620
5 to 9 years	19,142	9,773	9,369	2,527	1,268	1,259	16,615	8,505	8,110	16,405	8,399	8,006
10 to 14 years	17,132	8,749	8,383	2,060	1,035	1,025	15,072	7,714	7,358	14,903	7,628	7,275
15 to 19 years	13,680	6,918	6,762	1,643	821	822	12,037	6,096	5,941	11,897	6,025	5,873
20 to 24 years	11,438	5,680	5,758	1,461	724	737	9,977	4,956	5,021	9,850	4,893	4,958
25 to 29 years	11,412	5,709	5,703	1,384	691	693	10,029	5,018	5,010	9,903	4,960	4,943
30 to 34 years	12,443	6,201	6,242	1,398	699	700	11,045	5,503	5,542	10,914	5,442	5,472
35 to 39 years	12,895	6,404	6,492	1,339	665	674	11,556	5,738	5,818	11,437	5,679	5,759
40 to 44 years	11,950	5,929	6,021	1,187	584	603	10,763	5,345	5,418	10,671	5,298	5,373
45 to 49 years	11,238	5,552	5,686	1,105	537	568	10,133	5,015	5,118	10,054	4,971	5,083
50 to 54 years	10,105	4,965	5,140	969	469	500	9,136	4,497	4,640	9,068	4,455	4,613
55 to 59 years	8,675	4,187	4,489	818	389	429	7,858	3,798	4,059	7,803	3,765	4,038
60 to 64 years	7,561	3,560	4,000	660	314	346	6,900	3,246	3,654	6,858	3,222	3,636
65 to 69 years	6,443	2,984	3,459	477	226	251	5,966	2,758	3,208	5,934	2,741	3,193
70 to 74 years	4,756	2,146	2,609	303	138	165	4,452	2,008	2,444	4,430	1,994	2,435
75 years and over	5,782	2,429	3,353	338	149	190	5,444	2,280	3,163	5,420	2,266	3,155
NET UNDERCOUNT												
All ages	6,157	3,491	2,666	1,710	1,061	649	4,447	2,430	2,017	4,377	2,410	1,967
Under 5 years	506	306	201	182	104	79	324	202	122	301	190	110
5 to 9 years	450	269	181	122	67	55	328	201	127	317	196	121
10 to 14 years	358	224	134	89	51	38	270	174	96	264	172	93
15 to 19 years	461	284	177	153	87	66	307	197	111	289	188	102
20 to 24 years	637	408	229	242	153	88	396	255	141	380	247	133
25 to 29 years	543	376	167	195	139	56	348	237	111	347	238	109
30 to 34 years	494	355	139	166	131	35	328	224	104	325	224	101
35 to 39 years	414	324	90	115	92	23	300	232	67	297	232	65
40 to 44 years	350	253	97	97	71	25	253	182	71	248	181	67
45 to 49 years	358	194	164	86	52	34	272	142	130	269	142	126
50 to 54 years	499	231	269	123	62	60	376	168	208	375	169	205
55 to 59 years	246	60	186	86	33	53	159	26	133	177	37	140
60 to 64 years	418	151	267	111	52	59	307	99	208	307	100	207
65 to 69 years	185	53	132	-11	-4	-8	196	57	139	195	57	138
70 to 74 years	17	-39	56	-21	-14	-7	38	-25	63	39	-24	63
75 years and over	220	42	177	-25	-16	-9	245	59	186	247	60	186
PERCENT NET UNDERCOUNT*												
All ages	3.3	3.8	2.8	8.3	10.4	6.2	2.7	3.0	2.4	2.7	3.0	2.4
Under 5 years	2.4	2.9	2.0	6.3	7.1	5.4	1.8	2.2	1.4	1.7	2.1	1.3
5 to 9 years	2.4	2.8	1.9	4.8	5.3	4.3	2.0	2.4	1.6	1.9	2.3	1.5
10 to 14 years	2.1	2.6	1.6	4.3	4.9	3.7	1.8	2.3	1.3	1.8	2.2	1.3
15 to 19 years	3.4	4.1	2.6	9.3	10.6	8.1	2.6	3.2	1.9	2.4	3.1	1.7
20 to 24 years	5.6	7.2	4.0	16.5	21.2	12.0	4.0	5.1	2.8	3.9	5.0	2.7
25 to 29 years	4.8	6.6	2.9	14.1	20.2	8.1	3.5	4.7	2.2	3.5	4.8	2.2
30 to 34 years	4.0	5.7	2.2	11.9	18.8	5.0	3.0	4.1	1.9	3.0	4.1	1.9
35 to 39 years	3.2	5.1	1.4	8.6	13.8	3.4	2.6	4.1	1.2	2.6	4.1	1.1
40 to 44 years	2.9	4.3	1.6	8.1	12.2	4.2	2.4	3.4	1.3	2.3	3.4	1.2
45 to 49 years	3.2	3.5	2.9	7.8	9.7	6.0	2.7	2.8	2.5	2.7	2.9	2.5
50 to 54 years	4.9	4.6	5.2	12.7	13.3	12.1	4.1	3.7	4.5	4.1	3.8	4.5
55 to 59 years	2.8	1.4	4.1	10.6	8.6	12.4	2.0	0.7	3.3	2.3	1.0	3.5
60 to 64 years	5.5	4.2	6.7	16.8	16.5	17.1	4.5	3.0	5.7	4.5	3.1	5.7
65 to 69 years	2.9	1.8	3.8	-2.3	-1.6	-3.0	3.3	2.1	4.3	3.3	2.1	4.3
70 to 74 years	0.4	-1.8	2.1	-6.9	-10.1	-4.3	0.8	-1.3	2.6	0.9	-1.2	2.6
75 years and over	3.8	1.7	5.3	-7.4	-11.0	-4.6	4.5	2.6	5.9	4.5	2.7	5.9

*Base of percent is estimated population.

Note: Estimates include an allowance for undocumented immigration corresponding to 3 million undocumented residents in 1980. See text for derivation of estimated population.

Table A.50.1. Estimated Population and Amount and Percent of Net Undercount From Demographic Analysis for the Total Resident Population by Age, Sex, and Race: 1950

(Populations in thousands. All figures rounded independently. A minus sign denotes a net overcount)

Population and age	All races			Black			White-and-other races			White		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
ESTIMATED POPULATION												
All ages	158,317	78,959	79,358	16,641	8,264	8,376	141,676	70,695	70,982	140,459	70,038	70,421
Under 5 years	17,062	8,722	8,339	2,081	1,047	1,034	14,981	7,676	7,305	14,816	7,592	7,224
5 to 9 years	13,668	6,977	6,691	1,657	833	824	12,011	6,145	5,866	11,876	6,076	5,800
10 to 14 years	11,527	5,867	5,660	1,491	748	743	10,036	5,119	4,917	9,921	5,061	4,860
15 to 19 years	11,289	5,703	5,586	1,413	710	704	9,876	4,994	4,882	9,767	4,938	4,829
20 to 24 years	12,277	6,113	6,163	1,431	715	716	10,846	5,398	5,448	10,729	5,339	5,390
25 to 29 years	12,889	6,415	6,473	1,389	693	696	11,500	5,723	5,777	11,387	5,664	5,723
30 to 34 years	12,096	6,022	6,074	1,250	617	633	10,846	5,405	5,441	10,756	5,358	5,398
35 to 39 years	11,540	5,741	5,799	1,192	583	609	10,348	5,158	5,189	10,269	5,114	5,155
40 to 44 years	10,644	5,312	5,332	1,081	529	552	9,563	4,783	4,780	9,493	4,740	4,753
45 to 49 years	9,461	4,699	4,762	963	467	496	8,498	4,232	4,266	8,440	4,196	4,244
50 to 54 years	8,685	4,285	4,400	826	406	420	7,859	3,879	3,981	7,811	3,850	3,961
55 to 59 years	7,944	3,932	4,012	649	324	326	7,295	3,609	3,686	7,256	3,587	3,669
60 to 64 years	6,596	3,255	3,341	477	234	243	6,119	3,021	3,098	6,088	3,001	3,087
65 years and over	12,641	5,915	6,726	740	360	380	11,901	5,555	6,345	11,850	5,522	6,328
NET UNDERCOUNT												
All ages	6,992	3,772	3,219	1,595	963	632	5,397	2,810	2,587	5,309	2,783	2,527
Under 5 years	818	446	373	196	103	93	622	343	280	609	336	273
5 to 9 years	406	231	175	126	70	56	280	161	119	265	154	111
10 to 14 years	359	182	177	134	69	65	225	113	112	217	111	105
15 to 19 years	618	361	257	186	114	72	432	247	185	422	242	180
20 to 24 years	727	467	261	196	147	48	532	319	212	522	315	207
25 to 29 years	583	409	174	135	105	30	448	304	144	437	299	138
30 to 34 years	524	366	158	138	99	39	386	267	119	377	264	113
35 to 39 years	245	195	51	49	49	-	196	146	50	192	147	45
40 to 44 years	403	219	184	108	60	49	294	159	136	288	158	130
45 to 49 years	359	153	205	100	46	53	259	107	152	259	109	150
50 to 54 years	389	142	247	121	54	67	268	89	180	267	89	178
55 to 59 years	691	292	399	133	59	74	558	233	325	554	232	322
60 to 64 years	522	207	314	91	40	51	431	168	263	430	169	262
65 years and over	346	103	244	-118	-52	-66	465	155	310	469	157	312
PERCENT NET UNDERCOUNT*												
All ages	4.4	4.8	4.1	9.6	11.7	7.5	3.8	4.0	3.6	3.8	4.0	3.6
Under 5 years	4.8	5.1	4.5	9.4	9.8	9.0	4.2	4.5	3.8	4.1	4.4	3.8
5 to 9 years	3.0	3.3	2.6	7.6	8.4	6.8	2.3	2.6	2.0	2.2	2.5	1.9
10 to 14 years	3.1	3.1	3.1	9.0	9.2	8.8	2.2	2.2	2.3	2.2	2.2	2.2
15 to 19 years	5.5	6.3	4.6	13.2	16.1	10.2	4.4	4.9	3.8	4.3	4.9	3.7
20 to 24 years	5.9	7.6	4.2	13.7	20.6	6.8	4.9	5.9	3.9	4.9	5.9	3.8
25 to 29 years	4.5	6.4	2.7	9.7	15.2	4.3	3.9	5.3	2.5	3.8	5.3	2.4
30 to 34 years	4.3	6.1	2.6	11.0	16.1	6.1	3.6	4.9	2.2	3.5	4.9	2.1
35 to 39 years	2.1	3.4	0.9	4.1	8.3	-	1.9	2.8	1.0	1.9	2.9	0.9
40 to 44 years	3.8	4.1	3.5	10.0	11.3	8.8	3.1	3.3	2.8	3.0	3.3	2.7
45 to 49 years	3.8	3.3	4.3	10.4	9.9	10.7	3.0	2.5	3.6	3.1	2.6	3.5
50 to 54 years	4.5	3.3	5.6	14.6	13.2	16.0	3.4	2.3	4.5	3.4	2.3	4.5
55 to 59 years	8.7	7.4	9.9	20.5	18.3	22.8	7.7	6.5	8.8	7.6	6.5	8.8
60 to 64 years	7.9	6.4	9.4	19.1	17.0	21.0	7.0	5.5	8.5	7.1	5.6	8.5
65 years and over	2.7	1.7	3.6	-16.0	-14.4	-17.4	3.9	2.8	4.9	4.0	2.8	4.9

- Represents zero or rounds to zero.

*Base of percent is estimated population.

Note: See text for derivation of estimated population.

Table A.40.1. Estimated Population and Amount and Percent of Net Undercount From Demographic Analysis for the Total Resident Population by Age, Sex, and Race: 1940

(Populations in thousands. All figures rounded independently. A minus sign denotes a net overcount)

Population and age	All races			Black			White-and-other races			White		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
ESTIMATED POPULATION												
All ages	140,062	70,639	69,423	14,344	7,175	7,169	125,718	63,465	62,254	124,757	62,930	61,827
Under 5 years	11,613	5,920	5,693	1,515	761	754	10,098	5,159	4,939	9,980	5,099	4,881
5 to 9 years.....	11,372	5,791	5,582	1,431	720	710	9,942	5,070	4,872	9,835	5,017	4,819
10 to 14 years.....	12,457	6,340	6,117	1,466	738	728	10,991	5,602	5,390	10,880	5,546	5,334
15 to 19 years.....	13,082	6,631	6,451	1,448	727	721	11,634	5,904	5,730	11,526	5,849	5,677
20 to 24 years.....	12,306	6,185	6,120	1,317	655	662	10,988	5,530	5,459	10,901	5,486	5,415
25 to 29 years.....	11,774	5,900	5,874	1,267	623	643	10,507	5,276	5,231	10,428	5,231	5,197
30 to 34 years.....	10,947	5,499	5,448	1,169	575	594	9,778	4,924	4,855	9,706	4,879	4,827
35 to 39 years.....	9,896	4,956	4,939	1,072	524	548	8,823	4,433	4,391	8,762	4,394	4,368
40 to 44 years.....	9,318	4,675	4,643	955	476	479	8,364	4,199	4,164	8,311	4,168	4,143
45 to 49 years.....	8,834	4,488	4,346	793	404	389	8,041	4,084	3,956	7,997	4,059	3,938
50 to 54 years.....	7,717	3,955	3,762	621	313	308	7,096	3,642	3,454	7,059	3,618	3,441
55 years and over	20,746	10,299	10,447	1,290	657	633	19,456	9,642	9,814	19,372	9,585	9,787
NET UNDERCOUNT												
All ages	7,897	4,290	3,607	1,478	906	573	6,419	3,384	3,035	6,400	3,392	3,008
Under 5 years	1,024	541	483	266	140	127	758	401	356	741	393	348
5 to 9 years.....	637	346	291	136	77	59	501	270	232	498	268	230
10 to 14 years.....	658	360	297	135	77	58	523	284	239	519	283	236
15 to 19 years.....	694	421	273	143	97	46	551	324	227	550	325	225
20 to 24 years.....	660	457	203	122	105	17	538	352	186	537	353	183
25 to 29 years.....	628	418	210	122	94	28	506	324	182	506	327	179
30 to 34 years.....	666	403	262	176	107	69	489	296	193	486	297	188
35 to 39 years.....	316	190	126	86	61	25	230	128	101	234	133	101
40 to 44 years.....	504	240	264	140	75	64	365	165	200	366	168	199
45 to 49 years.....	557	267	290	100	56	45	457	211	246	456	212	245
50 to 54 years.....	441	190	251	71	30	40	370	160	210	372	162	210
55 years and over	1,111	455	656	-19	-13	-6	1,130	468	662	1,135	470	664
PERCENT NET UNDERCOUNT*												
All ages	5.6	6.1	5.2	10.3	12.6	8.0	5.1	5.3	4.9	5.1	5.4	4.9
Under 5 years	8.8	9.1	8.5	17.6	18.3	16.8	7.5	7.8	7.2	7.4	7.7	7.1
5 to 9 years.....	5.6	6.0	5.2	9.5	10.6	8.3	5.0	5.3	4.8	5.1	5.3	4.8
10 to 14 years.....	5.3	5.7	4.9	9.2	10.4	8.0	4.8	5.1	4.4	4.8	5.1	4.4
15 to 19 years.....	5.3	6.4	4.2	9.9	13.3	6.4	4.7	5.5	4.0	4.8	5.6	4.0
20 to 24 years.....	5.4	7.4	3.3	9.3	16.1	2.5	4.9	6.4	3.4	4.9	6.4	3.4
25 to 29 years.....	5.3	7.1	3.6	9.6	15.0	4.3	4.8	6.1	3.5	4.9	6.3	3.4
30 to 34 years.....	6.1	7.3	4.8	15.1	18.7	11.6	5.0	6.0	4.0	5.0	6.1	3.9
35 to 39 years.....	3.2	3.8	2.6	8.1	11.7	4.6	2.6	2.9	2.3	2.7	3.0	2.3
40 to 44 years.....	5.4	5.1	5.7	14.6	15.8	13.4	4.4	3.9	4.8	4.4	4.0	4.8
45 to 49 years.....	6.3	5.9	6.7	12.7	13.8	11.5	5.7	5.2	6.2	5.7	5.2	6.2
50 to 54 years.....	5.7	4.8	6.7	11.4	9.6	13.2	5.2	4.4	6.1	5.3	4.5	6.1
55 years and over	5.4	4.4	6.3	-1.5	-2.0	-1.0	5.8	4.9	6.7	5.9	4.9	6.8

*Base of percent is estimated population.

Note: See text for derivation of estimated population.

Appendix B.—Census Counts by Age, Sex, and Race: 1980, 1970, 1960, 1950, and 1940

Table B.80.1. Census Counts for the Total Resident Population by Age, Sex, and Modified Race: 1980

(Populations in thousands. All figures rounded independently)

Age group	All races			Black			White-and-other races			White		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
All ages	226,546	110,053	116,493	26,683	12,612	14,071	199,862	97,441	102,422	194,713	94,924	99,788
Under 5 years	16,348	8,362	7,986	2,459	1,240	1,220	13,889	7,122	6,767	13,414	6,882	6,532
5 to 9 years	16,700	8,539	8,161	2,509	1,265	1,245	14,191	7,274	6,916	13,717	7,034	6,683
10 to 14 years	18,242	9,316	8,926	2,691	1,353	1,338	15,551	7,963	7,588	15,095	7,730	7,365
15 to 19 years	21,168	10,755	10,413	3,007	1,500	1,506	18,161	9,255	8,906	17,681	9,008	8,673
20 to 24 years	21,319	10,663	10,655	2,749	1,313	1,436	18,569	9,350	9,219	18,072	9,102	8,970
25 to 29 years	19,521	9,705	9,816	2,342	1,095	1,247	17,179	8,610	8,569	16,658	8,363	8,295
30 to 34 years	17,561	8,677	8,884	1,904	879	1,025	15,657	7,798	7,859	15,157	7,565	7,592
35 to 39 years	13,965	6,862	7,104	1,469	667	801	12,497	6,194	6,303	12,122	6,014	6,108
40 to 44 years	11,669	5,708	5,961	1,260	571	689	10,409	5,137	5,272	10,110	4,991	5,119
45 to 49 years	11,090	5,388	5,702	1,150	519	632	9,939	4,870	5,070	9,693	4,755	4,938
50 to 54 years	11,710	5,621	6,089	1,135	507	628	10,575	5,113	5,462	10,360	5,016	5,344
55 to 59 years	11,615	5,482	6,133	1,041	469	573	10,574	5,013	5,560	10,394	4,928	5,466
60 to 64 years	10,088	4,670	5,418	874	386	488	9,214	4,283	4,930	9,078	4,221	4,858
65 to 69 years	8,782	3,903	4,880	779	333	447	8,003	3,570	4,433	7,892	3,517	4,375
70 to 74 years	6,798	2,854	3,945	565	235	330	6,233	2,619	3,614	6,153	2,578	3,575
75 years and over	9,969	3,548	6,420	748	281	467	9,221	3,267	5,954	9,117	3,221	5,896

Table B.80.2. Estimated Census Counts of Legal Residents by Age, Sex, and Modified Race: 1980

(Populations in thousands. All figures rounded independently)

Population and age	All races			Black			White-and-other races			White		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
ESTIMATED POPULATION												
All ages	224,489	108,959	115,530	26,486	12,517	13,969	198,004	96,442	101,561	192,989	93,996	98,993
Under 5 years	16,262	8,318	7,944	2,454	1,237	1,217	13,808	7,081	6,727	13,336	6,842	6,494
5 to 9 years	16,561	8,466	8,095	2,500	1,260	1,241	14,061	7,207	6,855	13,592	6,968	6,624
10 to 14 years	18,096	9,243	8,853	2,679	1,347	1,332	15,417	7,896	7,521	14,968	7,667	7,302
15 to 19 years	20,942	10,631	10,311	2,984	1,489	1,495	17,958	9,142	8,815	17,487	8,900	8,587
20 to 24 years	20,928	10,440	10,488	2,718	1,297	1,421	18,210	9,143	9,067	17,729	8,903	8,826
25 to 29 years	19,151	9,500	9,651	2,309	1,079	1,230	16,842	8,421	8,421	16,345	8,187	8,159
30 to 34 years	17,290	8,533	8,756	1,876	865	1,011	15,413	7,668	7,745	14,937	7,447	7,489
35 to 39 years	13,789	6,769	7,020	1,448	657	791	12,341	6,112	6,229	11,986	5,943	6,043
40 to 44 years	11,562	5,651	5,911	1,247	565	683	10,315	5,087	5,228	10,026	4,947	5,079
45 to 49 years	11,034	5,362	5,671	1,142	515	627	9,892	4,847	5,044	9,652	4,736	4,915
50 to 54 years	11,682	5,608	6,074	1,130	505	625	10,552	5,103	5,449	10,339	5,006	5,333
55 to 59 years	11,595	5,473	6,122	1,038	467	571	10,557	5,006	5,551	10,380	4,922	5,458
60 to 64 years	10,077	4,666	5,411	872	386	486	9,204	4,280	4,925	9,070	4,217	4,853
65 to 69 years	8,774	3,901	4,874	778	332	446	7,997	3,568	4,428	7,886	3,515	4,371
70 to 74 years	6,792	2,853	3,940	564	235	329	6,229	2,618	3,611	6,149	2,577	3,572
75 years and over	9,955	3,545	6,410	746	281	465	9,209	3,264	5,944	9,106	3,218	5,888

Note: Census counts are adjusted to exclude the estimated 2.06 million undocumented residents counted.

Table B.70.1. Census Counts for the Total Resident Population by Age, Sex, and Race: 1970

(Populations in thousands. All figures rounded independently)

Age group	All races			Black			White-and-other races			White		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
All ages	203,302	98,959	104,343	22,589	10,753	11,836	180,713	88,206	92,507	178,155	86,935	91,220
Under 5 years	17,167	8,752	8,415	2,435	1,221	1,214	14,732	7,532	7,201	14,468	7,398	7,070
5 to 9 years	19,974	10,178	9,796	2,750	1,379	1,372	17,224	8,799	8,425	16,945	8,658	8,286
10 to 14 years	20,809	10,601	10,208	2,813	1,408	1,405	17,996	9,193	8,803	17,728	9,059	8,670
15 to 19 years	19,092	9,645	9,446	2,426	1,203	1,223	16,666	8,442	8,224	16,419	8,317	8,101
20 to 24 years	16,393	7,932	8,461	1,817	841	975	14,576	7,090	7,486	14,336	6,973	7,364
25 to 29 years	13,490	6,629	6,861	1,430	658	771	12,061	5,971	6,090	11,853	5,872	5,982
30 to 34 years	11,440	5,600	5,839	1,254	569	686	10,185	5,032	5,154	10,002	4,943	5,059
35 to 39 years	11,116	5,417	5,699	1,197	541	656	9,919	4,876	5,043	9,751	4,799	4,952
40 to 44 years	11,992	5,824	6,168	1,199	544	655	10,792	5,280	5,513	10,636	5,209	5,427
45 to 49 years	12,128	5,857	6,271	1,124	521	603	11,004	5,336	5,668	10,871	5,271	5,600
50 to 54 years	11,114	5,353	5,761	991	459	532	10,124	4,894	5,230	10,023	4,843	5,179
55 to 59 years	9,982	4,770	5,212	874	405	469	9,108	4,365	4,743	9,024	4,320	4,704
60 to 64 years	8,626	4,031	4,595	735	335	400	7,891	3,696	4,195	7,821	3,656	4,165
65 to 69 years	6,998	3,125	3,873	628	277	350	6,371	2,848	3,523	6,312	2,815	3,497
70 to 74 years	5,449	2,317	3,132	416	184	232	5,033	2,133	2,900	4,992	2,112	2,880
75 years and over	7,533	2,928	4,605	501	208	293	7,032	2,720	4,312	6,975	2,691	4,284

Table B.60.1. Census Counts for the Total Resident Population by Age, Sex, and Race: 1960

(Populations in thousands. All figures rounded independently)

Age group	All races			Black			White-and-other races			White		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
All ages	179,323	88,331	90,992	18,872	9,114	9,758	160,451	79,217	81,233	158,832	78,367	80,465
Under 5 years	20,321	10,330	9,991	2,731	1,363	1,368	17,590	8,967	8,623	17,359	8,849	8,509
5 to 9 years	18,692	9,504	9,187	2,405	1,201	1,204	16,287	8,304	7,983	16,088	8,202	7,885
10 to 14 years	16,773	8,524	8,249	1,971	984	987	14,802	7,540	7,262	14,639	7,457	7,182
15 to 19 years	13,219	6,634	6,586	1,489	734	755	11,730	5,900	5,830	11,608	5,837	5,771
20 to 24 years	10,801	5,272	5,528	1,219	571	649	9,581	4,702	4,880	9,471	4,646	4,825
25 to 29 years	10,869	5,333	5,536	1,188	552	636	9,681	4,781	4,900	9,556	4,722	4,834
30 to 34 years	11,949	5,846	6,103	1,232	568	664	10,717	5,278	5,438	10,589	5,218	5,371
35 to 39 years	12,481	6,080	6,402	1,225	574	651	11,256	5,506	5,750	11,141	5,447	5,694
40 to 44 years	11,600	5,676	5,924	1,091	512	578	10,510	5,163	5,346	10,423	5,117	5,306
45 to 49 years	10,879	5,358	5,522	1,018	485	534	9,861	4,873	4,988	9,785	4,828	4,957
50 to 54 years	9,606	4,735	4,871	846	406	440	8,760	4,328	4,432	8,694	4,286	4,408
55 to 59 years	8,430	4,127	4,303	731	355	376	7,699	3,772	3,927	7,626	3,729	3,898
60 to 64 years	7,142	3,409	3,733	549	262	287	6,593	3,147	3,446	6,551	3,122	3,429
65 to 69 years	6,258	2,931	3,327	488	230	258	5,770	2,701	3,068	5,739	2,684	3,055
70 to 74 years	4,739	2,185	2,554	324	152	172	4,415	2,033	2,381	4,391	2,018	2,373
75 years and over	5,563	2,387	3,176	364	165	198	5,199	2,222	2,978	5,174	2,206	2,968

Table B.50.1. Census Counts for the Total Resident Population by Age, Sex, and Race: 1950

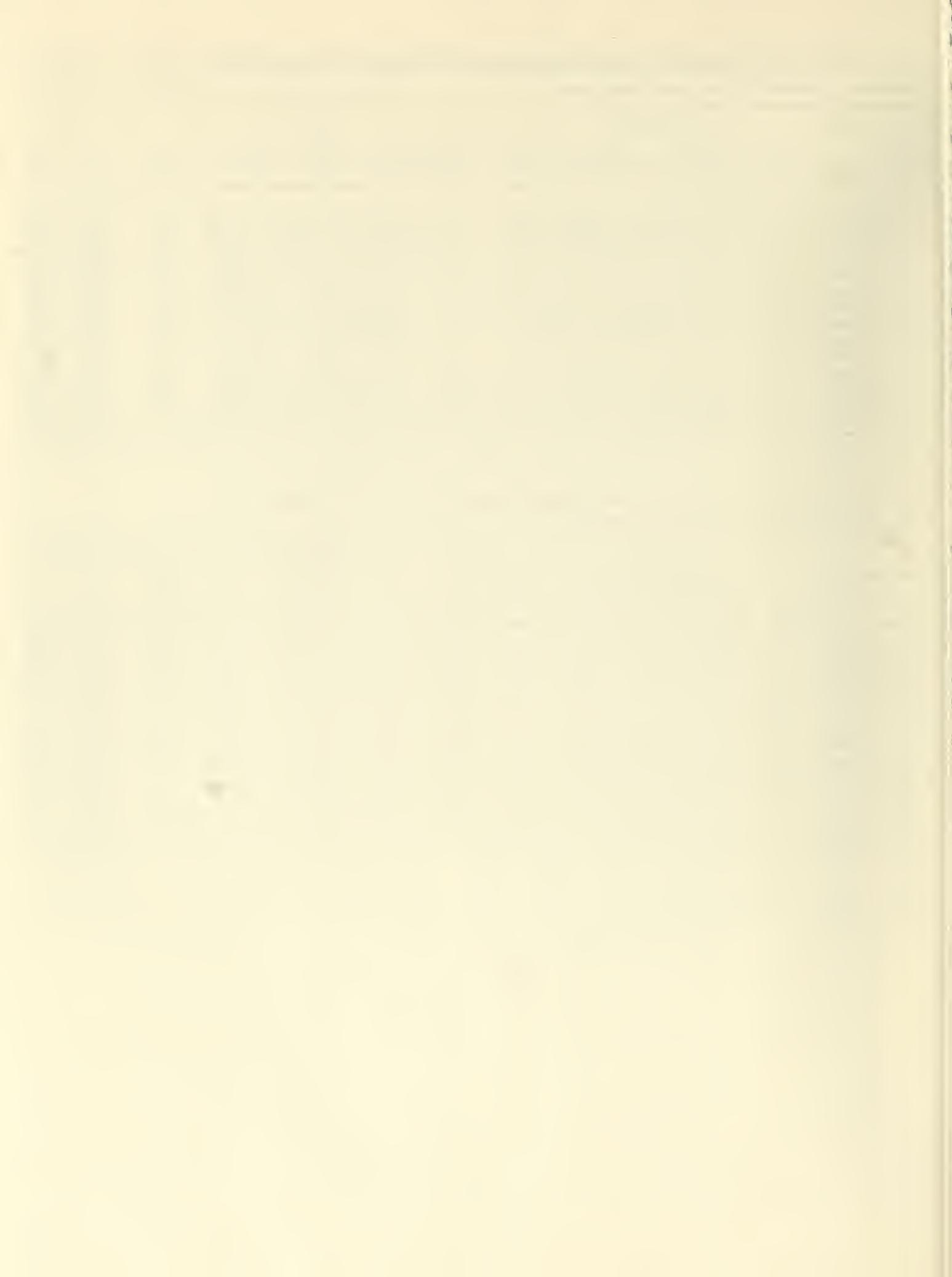
(Populations in thousands. All figures rounded independently)

Age group	All races			Black			White-and-other races			White		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
All ages	151,326	75,187	76,139	15,046	7,302	7,744	136,280	67,885	68,395	135,150	67,255	67,895
Under 5 years	16,243	8,277	7,966	1,884	944	940	14,359	7,333	7,026	14,207	7,256	6,951
5 to 9 years	13,262	6,747	6,516	1,531	763	768	11,731	5,983	5,748	11,611	5,922	5,689
10 to 14 years	11,167	5,685	5,483	1,356	679	678	9,811	5,006	4,805	9,704	4,949	4,755
15 to 19 years	10,671	5,342	5,329	1,227	595	632	9,444	4,747	4,697	9,345	4,697	4,649
20 to 24 years	11,549	5,647	5,903	1,235	568	667	10,314	5,079	5,235	10,207	5,024	5,183
25 to 29 years	12,306	6,007	6,299	1,254	587	666	11,052	5,419	5,633	10,950	5,364	5,586
30 to 34 years	11,572	5,656	5,917	1,113	518	595	10,460	5,138	5,322	10,380	5,095	5,285
35 to 39 years	11,294	5,547	5,748	1,143	534	609	10,151	5,012	5,139	10,077	4,967	5,110
40 to 44 years	10,241	5,093	5,148	973	469	503	9,268	4,624	4,644	9,204	4,582	4,623
45 to 49 years	9,102	4,546	4,556	863	421	442	8,239	4,125	4,114	8,180	4,087	4,094
50 to 54 years	8,296	4,142	4,153	705	352	353	7,591	3,790	3,801	7,544	3,761	3,783
55 to 59 years	7,253	3,640	3,613	516	264	251	6,737	3,375	3,361	6,702	3,355	3,347
60 to 64 years	6,074	3,047	3,027	386	194	192	5,688	2,853	2,835	5,657	2,832	2,825
65 years and over	12,295	5,813	6,482	859	412	447	11,436	5,401	6,035	11,381	5,365	6,016

Table B.40.1. Census Counts for the Total Resident Population by Age, Sex, and Race: 1940

(Populations in thousands. All figures rounded independently)

Age group	All races			Black			White-and-other races			White		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
All ages	132,165	66,350	65,815	12,866	6,269	6,596	119,300	60,081	59,219	118,358	59,539	58,819
Under 5 years	10,589	5,379	5,210	1,249	622	627	9,340	4,757	4,583	9,239	4,706	4,533
5 to 9 years	10,735	5,444	5,291	1,295	644	651	9,440	4,801	4,640	9,337	4,749	4,589
10 to 14 years	11,800	5,980	5,820	1,331	661	669	10,469	5,318	5,151	10,361	5,263	5,098
15 to 19 years	12,388	6,209	6,178	1,305	630	675	11,083	5,579	5,504	10,977	5,524	5,452
20 to 24 years	11,645	5,728	5,917	1,195	550	645	10,450	5,178	5,272	10,364	5,132	5,232
25 to 29 years	11,146	5,482	5,664	1,145	530	616	10,000	4,952	5,048	9,922	4,903	5,018
30 to 34 years	10,282	5,095	5,186	993	468	525	9,289	4,628	4,661	9,220	4,581	4,639
35 to 39 years	9,579	4,767	4,813	986	463	523	8,594	4,304	4,289	8,528	4,261	4,267
40 to 44 years	8,814	4,435	4,379	815	400	415	7,999	4,034	3,965	7,945	4,000	3,945
45 to 49 years	8,277	4,221	4,055	693	348	345	7,584	3,873	3,711	7,541	3,847	3,693
50 to 54 years	7,276	3,765	3,511	550	283	267	6,725	3,482	3,244	6,687	3,456	3,231
55 years and over	19,635	9,844	9,791	1,309	670	639	18,326	9,174	9,152	18,238	9,114	9,123



Appendix C.—Basic Data Sources and References for Demographic Analysis

I. Population Under Age 45 in 1980

A. Birth Statistics

Registered births, 1935-1980

National Center for Health Statistics, *Vital Statistics of the United States*, "Nativity," annual volumes

Estimates of birth underregistration, 1935-1980

1964-68

U.S. Bureau of the Census, *Census of Population and Housing: 1970, Evaluation and Research Program*, PHC(E)-2, "Test of Birth Registration Completeness, 1964 to 1968"

1950, 1940

U.S. Public Health Service, National Office of Vital Statistics, *Vital Statistics of the United States*, Volume 1, Chapter 6

Regression-based estimates for Whites, 1940, 1950, and 1964-68

Passel, Jeffrey S., Norfleet W. Rives, and J. Gregory Robinson, "A Regression Method for Estimating the Completeness of Registration of White Births for States," paper presented at the 1977 annual meetings of the Population Association of America, St. Louis, Missouri

Details of the methodology involving the birth statistics can be found in U.S. Bureau of the Census, *1980 Census Preliminary Evaluation Results Memorandum Series*, Number 112, "Methodology for Developing Estimates of Coverage in the 1980 Census Based on Demographic Analysis: Birth and Death Statistics, 1935-80," by Jeffrey S. Passel and J. Gregory Robinson, 1987

B. Death Statistics

Registered deaths, 1935-1980

National Center for Health Statistics, *Vital Statistics of the United States*, "Mortality," annual volumes

Survival rates, 1940-1980 (Used in estimation of net immigration components)

Derived from National Center for Health Statistics, *United States Life Tables: 1979-81, 1969-71, 1959-61, 1949-51, and 1939-41*

Details of the methodology involving the death statistics can be found in U.S. Bureau of the Census, *1980 Census Preliminary Evaluation Results Memorandum Series*, No. 112, *op. cit.*

C. Immigration Statistics

1. Legal immigration components

Legal alien immigration, 1935-1980

1950-1980—Immigration and Naturalization Service (INS), annual reports

1935-1950—estimated from 1950 and 1940 U.S. census data on the foreign-born population

Net immigration from Puerto Rico, 1940-1980

Estimated from 1980, 1970, 1960, 1950, 1940 U.S. census data on the Puerto Rican population and 1980, 1970 Puerto Rican census data on the U.S.-born population

Net arrival of civilian citizens, 1940-1980

1970-1980—estimated on the basis of data from the Department of Defense and Department of State

1940-1970—estimated from 1970, 1960, and 1950 United States census data on the civilian population overseas

Net arrival of foreign students, 1940-1980

1980—Immigration and Naturalization Service, unpublished tabulations

1940-70—estimated on the basis of data from the Institute of International Education

Appendix C.—Basic Data Sources and References

Net military movement overseas, 1940-1980
1940-1980—Department of Defense

Details of the methodology involving the legal immigration components can be found in U.S. Bureau of the Census, *1980 Census Preliminary Evaluation Results Memorandum Series*, Number 113, "Methodology for Developing Estimates of Coverage in the 1980 Census Based on Demographic Analysis: Immigration Statistics (Legal), 1935-1980," by Jeffrey S. Passel and J. Gregory Robinson, 1987

2. Legal emigration components, 1950-1980

Foreign-born Emigration, 1950-1980

1970-1980—level of emigration estimated from analysis of INS alien registration data. Age, sex, and race detail estimated from 1960-1970 emigration rates developed in Robert Warren and Jennifer Marks Peck, "Foreign-Born Emigration from the United States: 1960 to 1970," *Demography*, Vol. 17, No. 1 (February 1980), pp. 71-84

1950-1970—estimated from 1970, 1960, 1950 U.S. census data on the foreign-born population using the methods developed in Robert Warren and Jennifer Marks Peck, "Foreign-Born Emigration from the United States: 1960 to 1970," *Demography, op. cit.*

Native Emigration, 1940-1980

1940-1980—estimated on the basis of 1981, 1971, 1961, 1951, 1941 Canadian census data on the U.S.-born population

Details of the methodology involving the legal emigration components can be found in U.S. Bureau of the Census, *1980 Census Preliminary Evaluation Results Memorandum Series*, No. 113, *op. cit.*

D. Net Undocumented Immigration

Estimates of undocumented aliens counted in the 1980 census

Warren, Robert and Jeffrey S. Passel, "A Count of the Uncountable: Estimates of Undocumented Aliens Counted in the 1980 United States Census," *Demography*, Vol 24, No. 3, August 1987, pp. 375-393

Details of the methodology involving the estimation of net undocumented immigration can be found in U.S. Bureau of the Census, *1980 Census Preliminary Evaluation Results Memorandum Series*, Number 114, "Methodology for Developing Estimates of Coverage in the 1980 Census Based on Demographic Analysis: Net Undocumented Immigration," by Jeffrey S. Passel and J. Gregory Robinson, 1987

II. Population Aged 45 to 64 in 1980

A. White Population Aged 45 to 64 in 1980

Basic estimates of corrected White births, 1915-1935

National Office of Vital Statistics, *Vital Statistics Special Reports*, Vol. 33, No. 8, "Birth and Birth Rates in the Entire United States, 1909 to 1948," by P.K. Whelpton

Evaluation and adjustment of the Whelpton estimates

J. Gregory Robinson, "New Estimates of Corrected Births and Fertility, 1900-1935, and Birth Registration Completeness, 1920-1935, For the White Population of the United States," paper presented at the 1985 meetings of the Southern Regional Demographic Group, Austin, Texas

Survival rates, 1915-1940

Derived from *United States Life Tables, 1939-41, 1929-31, 1919-21, 1909-11*

Components of change 1940-80 (deaths, net immigration)

See sources for Population Under Age 45 in 1980

Details of the methodology involving the estimation of the corrected white population aged 45 to 64 in 1980 can be found in U.S. Bureau of the Census, *1980 Census Preliminary Evaluation Results Memorandum Series*, Number 115, "Methodology for Developing Estimates of Coverage in the 1980 Census Based on Demographic Analysis: Population Aged 45 to 64 in 1980," by Jeffrey S. Passel and J. Gregory Robinson, 1987

B. Black Population Aged 45 to 64 in 1980

Corrected Black female population, 1960, aged 24 to 44

Ansley J. Coale and Norfleet W. Rives, "A Statistical Reconstruction of the Black Population of the United States, 1880-1970: Estimates of True Numbers by Age and Sex, Birth Rates, and Total Fertility," *Population Index*, Vol. 39, No. 1, January 1973, pp. 3-36

Appendix C.—Basic Data Sources and References

Expected sex ratios, 1960 (Used to derive corrected Black male population)

Derived from *United States Life Tables, 1959-61, 1949-51, 1939-41, 1929-31, 1919-21, 1909-11*

Components of change, 1960-1980

See sources for Population Under Age 45 in 1980

Details of the methodology involving the estimation of the corrected Black population aged 45 to 64 in 1980 can be found in U.S. Bureau of the Census, *1980 Census Preliminary Evaluation Results Memorandum Series*, No. 115, *op. cit.*

C. Other-Races Population aged 45 to 64 in 1980

Corrected other-races female population

Estimated from interpolation of age patterns of undercount for other-races females at ages under 45 in 1980 (or under 35 in 1970, etc.) and at ages 65 and over (or 55 and over in 1970, etc.)

Corrected other-races male population

Estimated on basis of expected sex ratios calculated from interpolation of expected sex ratios for ages under 45 and ages over 65 in 1980

Details of the methodology involving the estimation of the corrected other-races population aged 45 to 64 in 1980 can be found in U.S. Bureau of the Census, *1980 Census Preliminary Evaluation Results Memorandum Series*, No. 115, *op. cit.*

III. Population Aged 65 Years and Over in 1980

Aggregate Medicare data, January 1, 1980 and July 1, 1980

Health Care Financing Administration, unpublished tabulations

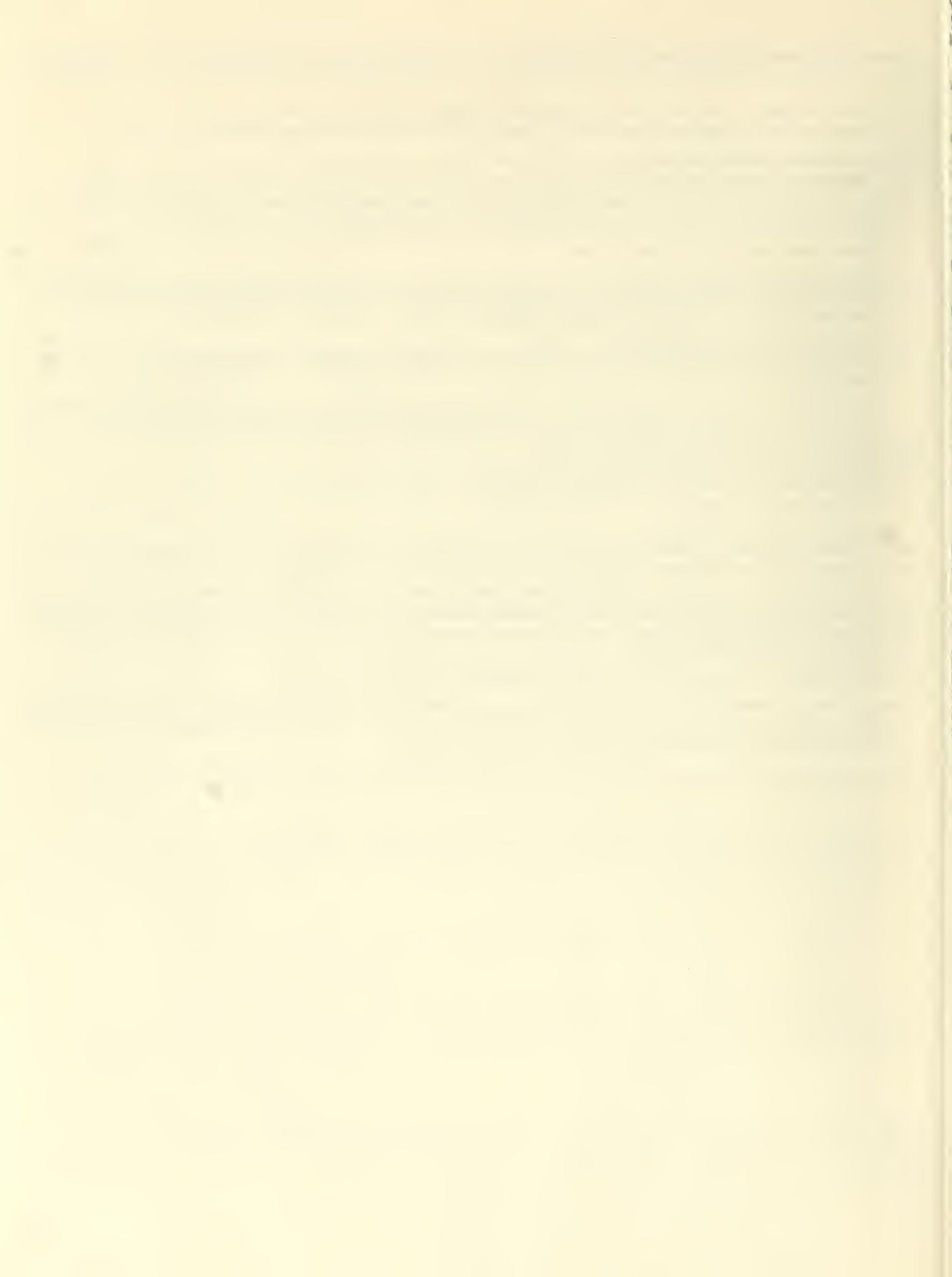
Adjustments for underenrollment

U.S. Bureau of the Census, "Estimates of Underenrollment in Aggregate Medicare Data for 1980," memorandum from J. Gregory Robinson to Jeffrey S. Passel, April 14, 1983

Details of the methodology involved the estimation of the corrected population 65 years and over in 1980 can be found in U.S. Bureau of the Census, *1980 Census Preliminary Evaluation Results Memorandum Series*, Number 116, "Methodology for Developing Estimates of Coverage in the 1980 Census Based on Demographic Analysis: Population Aged 65 and Over in 1980," by Jeffrey S. Passel and J. Gregory Robinson, 1987

IV. Development of Confidence Intervals for Demographic Estimates of Coverage

Passel, Jeffrey S., Prithwis Das Gupta, and J. Gregory Robinson, "Evaluation of Demographic Analysis: Development of Confidence Intervals," paper presented to the Census Advisory Committees of the American Statistical Association and on Population Statistics at the Joint Advisory Committee Meeting, October 8, 1987, Oxon Hill, MD.



Appendix D.—Detailed Tables of Estimates of Percent Net Undercount From the Post-Enumeration Program (PEP), by Age, Sex, and Race: 1980

Table D.1. Estimates of Percent Net Undercount from Demographic Analysis and Alternative PEP Estimates by Age and Sex for White-and-Other-Races Males: 1980

(Base of percent is estimated population. A minus sign denotes a net overcount. See text for explanation of alternative estimates)

Race, sex, and age group	Demographic Analysis (DA-2)	Post-Enumeration Program (PEP)											
		14-8	14-9	14-20	10-8	3-8	2-8	3-9	2-9	5-8	3-20	2-20	5-9
All ages.....	1.5	-1.3	-0.9	-0.5	0.1	0.5	0.6	0.8	1.0	1.7	1.2	1.3	2.1
Under 5 years.....	0.6	-0.5	-	0.3	1.2	1.4	1.5	1.9	2.0	3.0	2.2	2.3	3.6
5-9 years.....	0.7	-0.1	0.2	0.5	0.9	1.2	1.4	1.5	1.7	2.2	1.8	1.9	2.5
10-14 years.....	-0.1	-0.9	-0.7	-0.5	-	0.3	0.3	0.5	0.6	0.8	0.7	0.7	1.0
15-19 years.....	0.1	-1.0	-0.7	-0.4	-0.1	1.2	1.4	1.5	1.6	2.3	1.8	1.9	2.6
20-24 years.....	2.0	-0.9	-0.3	0.4	2.2	2.6	2.8	3.2	3.4	6.2	3.9	4.1	6.8
25-29 years.....	3.0	-2.2	-1.4	-1.1	0.8	0.5	0.9	1.3	1.7	3.3	1.6	2.0	4.1
30-34 years.....	1.9	-1.0	-0.4	-0.1	0.8	1.1	1.2	1.6	1.7	2.6	2.0	2.0	3.1
35-39 years.....	2.5	-1.4	-1.0	-0.6	-0.5	0.5	0.7	0.9	1.1	0.6	1.3	1.5	0.9
40-44 years.....	2.7	-1.0	-0.6	-0.3	-0.8	0.2	0.2	0.6	0.6	0.3	0.8	0.8	0.7
45-49 years.....	2.9	-1.8	-1.4	-1.2	-0.7	-0.6	-0.6	-0.3	-0.3	0.1	-	-	0.5
50-54 years.....	2.2	-1.5	-1.2	-0.9	-0.6	-0.8	-0.7	-0.5	-0.4	-0.2	-0.2	-0.1	0.2
55-59 years.....	2.3	-2.3	-2.2	-2.0	-1.5	-1.5	-1.4	-1.3	-1.2	-0.7	-1.1	-1.0	-0.5
60-64 years.....	1.7	-1.4	-1.2	-1.0	-0.8	-0.5	-0.4	-0.4	-0.3	-0.4	-0.1	-0.1	-0.3
65-69 years.....	-0.3	-1.7	-1.6	-1.4	-1.2	-1.2	-1.0	-1.1	-0.9	-1.0	-0.9	-0.7	-0.9
70-74 years.....	-0.2	-1.9	-1.8	-1.5	-1.5	-1.3	-1.2	-1.1	-1.0	-1.1	-0.8	-0.7	-0.9
75 years and over.....	0.9	-2.5	-2.4	-2.0	-1.9	-1.9	-1.6	-1.6	-1.5	-1.5	-1.3	-1.1	-1.4
Average absolute difference ¹ ..	(x)	2.9	2.5	2.2	1.8	1.7	1.7	1.6	1.6	1.9	1.6	1.5	1.9

(x) Not applicable.

- Represents zero or rounds to zero.

Note: Demographic analysis estimates include an allowance for 3 million undocumented residents in 1980. See text for derivation of estimated population. Estimates compared to census counts classified by modified race.

¹Average of the absolute difference of the demographic analysis estimate and PEP estimate of percent net undercount for each age group.

Table D.2. Estimates of Percent Net Undercount from Demographic Analysis and Alternative PEP Estimates by Age and Sex for White-and-Other-Races Females: 1980

(Base of percent is estimated population. A minus sign denotes a net overcount. See text for explanation of alternative estimates)

Race, sex, and age group	Demographic Analysis (DA-2)	Post-Enumeration Program (PEP)											
		14-8	14-9	14-20	10-8	3-8	2-8	3-9	2-9	5-8	3-20	2-20	5-9
All ages.....	-	-1.2	-1.0	-0.7	-0.3	0.2	0.3	0.4	0.5	1.0	0.7	0.8	1.3
Under 5 years.....	0.5	-0.4	-	0.3	0.8	1.6	1.9	1.9	2.2	2.4	2.2	2.5	2.8
5-9 years.....	0.6	-1.2	-0.9	-0.7	-0.1	0.3	0.3	0.6	0.6	1.1	0.8	0.8	1.4
10-14 years.....	-	-1.1	-0.9	-0.7	0.2	0.1	0.2	0.3	0.3	1.6	0.5	0.5	1.7
15-19 years.....	-0.4	-0.2	-	0.3	1.1	2.1	2.3	2.4	2.5	3.3	2.6	2.7	3.5
20-24 years.....	-	-1.0	-0.5	-	1.3	1.9	2.0	2.4	2.5	4.6	2.8	2.9	5.1
25-29 years.....	0.5	-1.6	-1.1	-0.8	-0.1	0.2	0.4	0.7	0.9	1.8	1.1	1.3	2.3
30-34 years.....	-0.6	-1.2	-0.8	-0.5	0.1	-0.2	-	0.2	0.3	1.2	0.5	0.6	1.6
35-39 years.....	-	-1.0	-0.8	-0.6	-0.9	-	0.1	-0.2	0.3	-0.3	0.4	0.5	-0.1
40-44 years.....	-0.1	-0.4	-0.2	-	-0.5	0.6	0.7	0.8	0.9	0.2	1.0	1.1	0.4
45-49 years.....	0.2	-1.2	-1.1	-0.8	-0.8	-0.4	-0.3	-0.3	-0.2	-0.2	-	0.1	-0.1
50-54 years.....	-0.4	-1.9	-1.8	-1.6	-0.8	-1.5	-1.2	-1.4	-1.1	-0.3	-1.2	-0.9	-0.2
55-59 years.....	-0.9	-2.1	-1.9	-1.8	-1.3	-1.5	-1.5	-1.3	-1.4	-0.8	-1.2	-1.2	-0.7
60-64 years.....	-0.4	-2.6	-2.4	-2.1	-1.6	-1.9	-1.9	-1.7	-1.7	-1.4	-1.4	-1.4	-1.2
65-69 years.....	-1.5	-2.0	-1.8	-1.6	-1.7	-1.4	-1.2	-1.2	-1.0	-1.5	-1.0	-0.8	-1.3
70-74 years.....	-0.3	-1.7	-1.6	-1.4	-1.9	-1.0	-0.9	-1.0	-0.9	-1.7	-0.7	-0.7	-1.6
75 years and over.....	2.6	-1.5	-1.5	1.3	-1.7	-0.2	-0.1	-0.2	-0.1	-1.4	-	0.1	-1.4
Average absolute difference ¹ ..	(x)	1.3	1.1	0.8	1.0	0.9	1.0	1.0	1.0	1.4	1.1	1.1	1.6

(x) Not applicable.

- Represents zero or rounds to zero.

Note: Demographic analysis estimates include an allowance for 3 million undocumented residents in 1980. See text for derivation of estimated population. Estimates compared to census counts classified by modified race.

¹Average of the absolute difference of the demographic analysis estimate and PEP estimate of percent net undercount for each age group.

Table D.3. Estimates of Percent Net Undercount from Demographic Analysis and Alternative PEP Estimates by Age and Sex for Black Males: 1980

(Base of percent is estimated population. A minus sign denotes a net overcount. See text for explanation of alternative estimates)

Race, sex, and age group	Demographic Analysis (DA-2)	Post-Enumeration Program (PEP)											
		14-8	14-9	14-20	10-8	3-8	2-8	3-9	2-9	5-8	3-20	2-20	5-9
All ages.....	8.8	1.0	2.4	3.1	3.2	6.3	6.8	7.4	8.1	5.4	8.2	8.8	6.7
Under 5 years.....	9.6	2.7	3.5	4.2	6.0	9.1	9.4	9.8	10.2	8.9	10.5	10.8	9.6
5-9 years.....	6.1	4.0	5.3	6.1	4.1	9.3	9.8	10.5	11.0	5.6	11.4	11.8	6.8
10-14 years.....	1.8	4.6	5.1	5.6	2.3	9.6	9.5	9.9	10.0	3.9	10.5	10.4	4.4
15-19 years.....	0.3	1.7	2.7	2.9	1.6	5.4	6.2	6.2	7.1	3.8	6.6	7.3	4.8
20-24 years.....	8.9	-1.5	0.4	1.1	4.4	6.2	8.2	7.6	9.9	8.7	8.6	10.6	10.4
25-29 years.....	12.7	-3.9	-1.4	0.2	3.4	3.3	3.8	5.5	6.2	6.3	7.2	7.7	8.6
30-34 years.....	13.4	-1.6	0.6	2.0	3.6	5.6	6.6	7.5	8.7	5.9	9.0	10.0	8.1
35-39 years.....	16.6	1.5	3.1	3.6	6.9	7.4	8.0	8.6	9.5	8.5	9.4	10.0	10.0
40-44 years.....	18.5	3.4	4.9	5.2	2.6	7.0	7.0	8.2	8.4	4.9	8.7	8.8	6.3
45-49 years.....	18.4	0.7	2.5	2.9	1.3	4.9	5.3	6.6	7.1	2.9	7.1	7.4	4.7
50-54 years.....	15.7	-0.8	0.8	1.1	1.1	3.7	3.9	5.3	5.6	1.8	5.6	5.8	3.4
55-59 years.....	10.8	2.7	3.3	3.7	3.5	5.0	5.4	5.5	6.1	4.4	6.0	6.5	4.9
60-64 years.....	6.7	-1.0	1.2	1.1	-0.4	1.6	1.7	3.7	3.8	0.4	3.6	3.7	2.8
65-69 years.....	-2.9	-0.5	-0.2	0.2	2.2	2.0	2.3	2.3	2.6	3.2	2.7	3.0	3.5
70-74 years.....	-1.8	-0.5	0.5	1.3	2.2	1.9	2.1	2.9	3.2	3.2	3.7	3.9	4.2
75 years and over.....	0.6	-5.0	-3.2	-2.3	-2.7	-2.6	-2.3	-0.7	-0.5	-1.7	0.2	0.5	0.3
Average absolute difference ¹ ..	(x)	9.0	8.0	7.5	7.2	6.6	6.3	5.8	5.7	6.1	5.6	5.6	5.4

(x) Not applicable.

Note: Demographic analysis estimates include an allowance for 3 million undocumented residents in 1980. See text for derivation of estimated population. Estimates compared to census counts classified by modified race.

¹Average of the absolute difference of the demographic analysis estimate and PEP estimate of percent net undercount for each age group.

Table D.4. Estimates of Percent Net Undercount from Demographic Analysis and Alternative PEP Estimates by Age and Sex for Black Females: 1980

(Base of percent is estimated population. A minus sign denotes a net overcount. See text for explanation of alternative estimates)

Race, sex, and age group	Demographic Analysis (DA-2)	Post-Enumeration Program (PEP)											
		14-8	14-9	14-20	10-8	3-8	2-8	3-9	2-9	5-8	3-20	2-20	5-9
All ages.....	3.1	1.1	2.1	2.6	2.5	5.3	5.5	6.2	6.4	3.8	6.7	6.9	4.7
Under 5 years.....	9.0	5.1	6.3	6.8	5.3	12.6	12.3	13.7	13.5	7.4	14.3	14.0	8.6
5-9 years.....	5.6	1.2	2.3	3.0	4.9	6.1	6.2	7.1	7.2	6.3	7.9	7.9	7.3
10-14 years.....	1.7	3.3	3.9	4.4	3.7	7.8	8.1	8.4	8.6	5.1	8.9	9.1	5.6
15-19 years.....	-0.2	1.7	2.2	2.8	3.7	4.5	4.8	5.0	5.3	5.0	5.6	5.9	5.5
20-24 years.....	2.8	-0.1	1.7	2.0	3.8	5.8	6.4	7.5	8.1	5.6	7.9	8.4	7.4
25-29 years.....	3.5	0.7	2.2	3.1	2.5	6.2	6.7	7.5	8.1	3.7	8.4	9.0	5.0
30-34 years.....	2.4	1.0	2.1	2.5	2.7	6.4	6.4	7.5	7.5	5.3	7.9	7.9	6.3
35-39 years.....	3.9	1.2	1.8	2.3	1.2	4.8	5.1	5.2	5.6	1.8	5.8	6.2	2.4
40-44 years.....	5.8	0.7	1.6	1.6	0.1	2.9	3.4	3.8	4.3	1.0	3.8	4.3	2.0
45-49 years.....	4.9	0.7	1.9	2.6	-1.6	2.8	2.9	4.0	4.1	-1.2	4.7	4.7	-
50-54 years.....	1.9	-0.6	-0.1	0.2	-	0.7	0.9	1.2	1.5	0.6	1.5	1.8	1.1
55-59 years.....	1.8	-0.5	-	0.5	-0.3	1.6	1.5	2.1	2.1	-0.1	2.7	2.5	0.5
60-64 years.....	0.4	-0.4	-0.1	0.4	-1.0	1.4	1.3	1.6	1.5	-0.7	2.1	2.0	-0.5
65-69 years.....	-6.6	-1.5	-0.5	-0.6	0.9	0.2	0.4	1.2	1.4	1.3	1.1	1.3	2.3
70-74 years.....	-2.4	-1.6	-0.6	-0.3	0.7	-	0.1	1.1	1.2	1.1	1.4	1.5	2.1
75 years and over.....	6.4	-1.9	-0.9	-1.1	0.5	-0.9	-2.0	0.1	0.1	0.9	-0.1	-0.1	1.8
Average absolute difference ¹ ..	(x)	3.2	2.6	2.4	3.1	3.1	3.2	3.5	3.6	3.2	3.8	3.9	3.3

(x) Not applicable.

- Represents zero or rounds to zero.

Note: Demographic analysis estimates include an allowance for 3 million undocumented residents in 1980. See text for derivation of estimated population. Estimates compared to census counts classified by modified race.

¹Average of the absolute difference of the demographic analysis estimate and PEP estimate of percent net undercount for each age group.

Appendix E.—Sex Ratios From the 1980 Census, Alternative Demographic Analysis Estimates, and Alternative PEP Estimates for the White-and-Other-Races and Black Populations, by Age: 1980

Table E. Sex Ratios from the 1980 Census, Alternative Demographic Analysis Estimates, and Alternative PEP Estimates for the White-and-Other-Races and Black Populations, by Age: 1980

(Sex ratio is males per 100 females. See text for explanation of alternative estimates)

Race, sex, and age group	Census	Demographic Analysis			Post-Enumeration Program (PEP)											
		DA-1	DA-2	DA-3	14-8	14-9	14-20	10-8	3-8	2-8	3-9	2-9	5-8	3-20	2-20	5-9
WHITE-AND-OTHER RACES																
All ages.....	95.1	96.5	96.5	96.6	95.1	95.2	95.3	95.5	95.4	95.4	95.5	95.6	95.8	95.6	95.6	95.9
Under 5 years.....	105.3	105.3	105.3	105.3	105.1	105.3	105.3	105.7	105.0	104.8	105.2	105.0	105.9	105.3	105.0	106.1
5-9 years.....	105.2	105.2	105.3	105.3	106.4	106.4	106.4	106.2	106.1	106.3	106.2	106.3	106.3	106.2	106.4	106.3
10-14 years.....	104.9	104.9	104.8	104.8	105.1	105.1	105.1	104.7	105.0	105.1	105.1	105.2	104.1	105.1	105.2	104.1
15-19 years.....	103.9	104.3	104.4	104.5	103.1	103.2	103.2	102.7	103.0	102.9	103.0	103.0	102.8	103.0	103.0	102.9
20-24 years.....	101.4	103.3	103.6	103.8	101.5	101.6	101.8	102.3	102.2	102.3	102.3	102.3	103.1	102.5	102.6	103.2
25-29 years.....	100.5	102.8	103.0	103.2	99.9	100.2	100.2	101.4	100.8	101.0	101.1	101.3	102.0	101.0	101.2	102.3
30-34 years.....	99.2	101.6	101.7	101.8	99.4	99.6	99.6	99.9	100.5	100.4	100.7	100.6	100.6	100.7	100.6	100.8
35-39 years.....	98.3	100.7	100.7	100.8	97.9	98.0	98.2	98.7	98.8	98.9	99.0	99.0	99.1	99.2	99.2	99.3
40-44 years.....	97.5	100.1	100.2	100.3	96.9	97.1	97.1	97.2	97.0	96.9	97.2	97.1	97.5	97.2	97.2	97.8
45-49 years.....	96.0	98.7	98.7	98.7	95.5	95.7	95.7	96.1	95.9	95.8	96.0	95.9	96.4	96.0	95.9	96.6
50-54 years.....	93.6	96.2	96.2	96.2	94.0	94.2	94.3	93.8	94.3	94.2	94.5	94.4	93.8	94.5	94.4	94.0
55-59 years.....	90.2	93.1	93.1	93.0	89.9	89.9	89.9	90.0	90.0	90.1	90.2	90.1	90.3	90.3	90.2	90.3
60-64 years.....	86.9	88.8	88.8	88.8	87.9	87.9	87.9	87.8	87.5	88.1	88.2	88.1	88.1	87.7	88.0	88.1
65-69 years.....	80.5	81.5	81.5	81.5	80.8	80.7	80.7	80.7	80.9	80.7	80.7	80.6	80.6	80.9	80.6	80.8
70-74 years.....	72.5	72.5	72.5	72.5	72.3	72.3	72.4	72.7	72.3	72.3	72.4	72.4	72.9	72.4	72.4	73.0
75 years and over....	54.9	53.9	53.9	53.9	54.3	54.4	54.5	54.7	54.0	54.1	54.1	54.2	54.8	54.2	54.3	54.8
BLACK																
All ages.....	89.6	95.2	95.2	95.2	89.6	89.9	90.0	90.3	90.5	90.9	90.1	91.2	91.1	91.0	91.4	91.5
Under 5 years.....	101.6	102.3	102.2	102.3	99.2	98.7	98.9	102.4	97.7	98.4	97.2	97.9	103.4	97.4	98.1	102.8
5-9 years.....	101.6	102.2	102.3	102.2	104.5	104.8	105.0	100.8	105.2	105.8	105.5	106.0	100.8	105.7	106.2	101.1
10-14 years.....	101.2	101.3	101.2	101.2	102.6	102.5	102.5	99.7	103.0	102.7	102.9	102.6	99.9	102.9	102.6	99.8
15-19 years.....	99.6	100.0	100.0	100.0	99.5	100.0	99.6	97.4	100.4	100.8	100.9	101.3	98.3	100.4	100.9	98.8
20-24 years.....	91.4	97.5	97.6	97.6	90.3	90.2	90.5	91.8	91.5	92.9	91.5	92.8	94.2	91.8	93.2	94.1
25-29 years.....	87.8	97.1	97.1	97.1	84.1	84.9	85.3	88.5	85.2	85.1	86.0	85.9	90.2	86.4	86.4	91.0
30-34 years.....	85.7	96.5	96.5	96.5	83.7	84.5	85.3	86.4	84.9	85.8	85.8	86.7	86.2	86.6	87.5	87.1
35-39 years.....	83.3	96.0	96.0	96.0	83.5	84.4	84.4	88.2	85.5	85.8	86.5	86.7	89.2	86.5	86.7	90.1
40-44 years.....	82.8	95.7	95.7	95.7	85.1	85.6	85.9	84.9	86.4	85.9	86.9	86.4	86.1	87.2	86.7	86.6
45-49 years.....	82.1	95.7	95.6	95.6	82.1	82.7	82.4	84.6	84.0	84.2	84.5	84.7	85.6	84.2	84.5	86.1
50-54 years.....	80.8	94.1	94.0	94.0	80.8	81.6	81.6	81.7	83.4	83.3	84.4	84.3	81.7	84.3	84.2	82.7
55-59 years.....	81.8	90.1	90.1	90.0	84.5	84.6	84.5	85.0	84.7	85.2	84.8	85.3	85.6	84.8	85.2	85.7
60-64 years.....	79.2	84.6	84.6	84.5	78.9	80.4	79.9	79.8	79.5	79.7	81.0	81.2	80.4	80.6	80.7	81.9
65-69 years.....	74.5	77.2	77.2	77.1	75.2	74.8	75.1	75.4	75.8	75.9	75.4	75.4	75.8	75.7	75.7	75.4
70-74 years.....	71.1	71.6	71.5	71.5	72.0	71.9	72.3	72.3	72.5	72.6	72.5	72.6	72.7	72.9	72.9	72.7
75 years and over....	60.3	56.8	56.8	56.8	58.6	59.1	59.7	58.6	59.4	59.5	59.9	60.0	59.0	60.5	60.6	59.5

Appendix F.—Estimation and Variance Estimation

Estimation

In PEP, estimates of total persons with specific characteristics are formed by summing the assigned weight for each sample case with those characteristics. For example, the PEP estimate of the number of census overenumerations due to definitional errors in a given State is based on summing the sample weights for all complete E-sample cases meeting these criteria, i.e., classified as census overenumerations due to definitional errors in the State.

Estimates of proportions are based on ratios of totals estimated from the weights. For example, the rate of erroneous enumerations is based on the ratio of the estimated total erroneous enumerations according to the preceding method to the estimated total enumerations.

Consequently, estimation questions in PEP reduce to the issue of how the weights were assigned to the sample cases. This appendix separately describes the procedures to determine the weights for the P and E samples.

THE APRIL AND AUGUST P SAMPLES

Weights for the P-sample cases were derived as the product of the following factors:

1. A "basic" weight representing the inverse of the probability of selection for the person, including any subsampling in the field;
2. A noninterview adjustment to attempt to compensate for whole household noninterviews;
3. A "first-stage" factor, itself a product of two factors, to provide a ratio adjustment for the first-stage selection of PSUs;

4. A "second-stage" factor, itself a product of two factors, to adjust the P-sample estimates to independent estimates of State and national population.

These weighting procedures closely resemble those for CPS labor force characteristics.¹

In estimation, the military sample was combined with the April and with the August CPS samples to give two samples of the non-institutional population. The "basic weights" were determined by the respective sampling designs for the civilian and military samples, but computation of all subsequent factors was based on the merged samples composed of either the April or August civilian samples combined with the military sample. Each of the factors is described in more detail by the following sections.

Basic Weight

The probability of selection of a sample case is equal to the product of the probability of selection for the Primary Sampling Unit (PSU), the conditional probability of selection of the sample segment within the PSU, and the probability of selection within the segment. For some PSUs, namely, the self-representing PSUs, the probability of selection of the PSU is 1.0 by definition. The probability of selection of non-self-representing PSUs is less than one.

The first stage of selection of the CPS design comprises two separate samples, the "A" and "C" samples, of PSUs. In larger States, double selections of the same PSU were allowed in the "A" and "C" samples. For purposes of estimation, the probability of selection in the A/C sample was formally taken to be 3/2 times the probability of selection of the PSU in the

"A" design rather than the true unconditional probability of selection of the PSU. This weighting procedure is consistent with the CPS practice of implementing a double sample in any PSU included in both the "A" and "C" samples. In the smaller States that were restratified and supplemented, the probability of selection was calculated conditionally on the restratification.

The sampling of segments within selected PSUs was based on assigned rates of selection within the PSU. For address and area segments sampled from the 1970 census, the probability of selection of a segment within a sampled PSU is the product of the probability of selection of the 1970 ED times the probability of selection of the segment within the ED.

As a rule, all housing units within a sampled segment fell into sample. Occasionally, however, segments were discovered to contain far more housing units than expected. In such cases, the segments were subsampled, further affecting the overall probability of selection.

The "basic" or "unbiased" weight is the reciprocal of the overall probability of selection, considering both the first-stage sampling of PSUs and the selection within the PSUs.

Noninterview Adjustment

The noninterview adjustment was a factor applied to interviewed households to represent noninterviewed households. The country was divided into 152 noninterview clusters, each of which contained either SMSA or non-SMSA PSUs. Each cluster in SMSA PSUs was divided into six cells according to race of head (white/other races) and geography (central city/urban balance/rural balance). The basic weights of interviewed and noninterviewed households were tallied for each of the six cells. Within each cell, a noninterview factor was computed:

¹U.S. Bureau of the Census, *The Current Population Survey: Design and Methodology*, Technical Paper 40, Washington, DC, 1978.

Appendix F.—Estimation and Variance Estimation

$$\text{NI Factor} = \frac{X_I + X_{NI}}{X_I},$$

where X_I represents the sum of basic weights of interviewed households and X_{NI} represents the sum of basic weights for noninterviewed households; this factor was applied to basic weights in interviewed households. Similar rules were applied in non-SMSA clusters for four cells according to race of head (white/other races) and geography (urban/rural).

Rules were specified to collapse cells within the noninterview cluster in instances where any of the factors computed from the original cells exceeded 2.0, or when noninterviewed households appeared without any interviewed households in the cell. As groups of cells were collapsed, the noninterview factor was computed in the same manner for the collapsed group and applied to each interviewed household in the set of collapsed cells.

First-Stage Factors

The first-stage factors applied for PEP were each the product of two factors, one at the regional and one at the State level. These factors represent ratio adjustments to compensate for variation due to the first stage of selection of PSUs. With the exception of Massachusetts, the first-stage factors were applied only to sample cases in non-self-representing PSUs.

Within each of the four census regions, six cells were defined by two race (white/non-white) and three geographic (SMSA central city/SMSA balance/non-SMSA) categories. The regional factor was the ratio of the 1970 census total population in the non-self-representing areas in the specific cell to the sample estimate of the same quantity formed by summing the products of the 1970 census values within each sampled non-self-representing PSU times the inverse of the probability of selection. (Again, in States with the original A/C stratification, this probability was taken as 3/2 times the "A" probability). When a PSU was both an "A" and "C" PSU, the product was doubled to represent the double selection. This ratio of census total to sample estimate was applied to sample cases in non-self-representing PSUs.

A second first-stage factor was computed in a similar manner on a State level for four cells for race (white/nonwhite) by

geography (urban/rural). The numerator of the factor was again the 1970 census total in non-self-representing areas for the cell, but the denominator was the sum of the inverse of the probability of selection of the non-self-representing PSU times the census total for the cell after application of the regional first-stage factors derived in the preceding step. Collapsing rules were applied when either regional or State factors exceeded a specified amount in any cell.

A special State factor was derived for Massachusetts for application to the non-SMSA self-representing areas in the State, since the only non-self-representing PSU in the State, a non-SMSA PSU, was not selected into sample. In effect, the factor employs non-SMSA self-representing areas to represent the non-SMSA non-self-representing area that did not fall into sample.

Second-Stage Factors

A final set of factors was applied to the April and August samples. One factor was based upon the ratio of an independent estimate of total population for each of the States to the sample estimate for PEP. The other adjusted for differences between independent estimates of national totals by age, race, and sex and the PEP survey results.

The factors were computed through the approach of iterative proportional fitting or "raking." First, a preliminary set of State ratios, with estimates of State population in the numerator and PEP sample estimates in the denominator, were computed and applied to the PEP sample estimates. Consequently, after this step the PEP sample estimates with the adjusted weights agreed with the independent estimates of State population. Next, the national demographic estimates were compared to the PEP sample estimates, including the application of State ratios in the previous step. Again, the ratios of the demographic estimates to the PEP sample estimates became a set of factors to adjust the sample estimates. After this second adjustment of the PEP weights, the resulting PEP State totals were compared to the independent State estimates. A new State ratio was computed, in effect updating the ratio at the first step. The PEP estimates

were proportionally adjusted again to conform to the given independent State estimates. This process of alternately adjusting to State totals and national demographic cells was iterated for a total of six cycles.

The independent estimates of population at both the State and national level were prepared by the Population Division of the Census Bureau. The estimates were based upon estimates of change between 1970 and 1980 and demographic estimates of undercount in the 1970 census. In the monthly processing of CPS, estimation of Labor Force and other characteristics employs a similar adjustment, reflecting population change between 1970 and 1980 but without a correction for undercount in the 1970 census.

The purpose of the second-stage adjustment for PEP was largely to produce more consistent estimates of total characteristics from the P sample. The effect of the adjustment on dual-system estimates was modest, however, since the adjustment factors for the most part canceled between the denominator and numerator of the dual-system estimator.

THE E SAMPLE

Weighting for the E sample paralleled that for the P sample, although there were a number of important differences. Special formulas were also required for the estimation of duplications. Weights for E sample cases reflected the same product of basic weight, noninterview adjustment, first-stage adjustment, and second-stage adjustment as the P sample. Specific features of these factors are described in the following sections.

Basic Weights

The inverse of the probability of selection for the E sample formed the basic weight.

Noninterview Adjustments

All households determined to be geocoding errors were exempted from the noninterview adjustment; such households were not used in the computation of the factor and were not adjusted by the resulting factor.

Appendix F.—Estimation and Variance Estimation

The noninterview adjustment for the E sample employed the same 152 noninterview clusters as the P sample. In place of adjustment cells defined by the race of head and geographic categories, the E sample employed 20 cells by sex, race, and broad age group (under 19, 19-24, 25-34, 35-59, 60 or more) at the level of persons. Unlike the P sample, which generally obtained only the race of head for nonresponding households, the E sample had available the reported demographic data from the census for persons residing in nonresponding households.

Collapsing rules were specified to combine cells in the noninterview adjustment to assure that the factors did not exceed 2.0.

First-Stage Adjustments

The first-stage factors for the E sample were computed in the same manner as the P sample, except that the urban/rural distinction was not employed at the State level because of the lack of comparability between 1970 and 1980 coding of this geographic characteristic.

Second-Stage Adjustment

A second-stage adjustment, again consisting of six cycles of iteration between State and national adjustments, was employed for the E sample. Two major differences with respect to the P sample may be noted, however. First, the control counts were those of the noninstitutional population, directly from the 1980 census. These counts excluded persons imputed in the census because of close-out, since these persons were not in the scope of the E sample. The second-stage adjustment also employed different cells. In place of the single State estimate in the P sample, 16 age by sex by race cells were employed for the E sample. Detailed demographic cells were employed in the adjustment at the national level, however, as with the P sample.

Estimation of Duplicates

The E-sample weights computed as the product of the preceding factors were used directly in the estimation of geocoding and

definitional errors. Further adjustments to these weights were required for the estimation of duplicates, however.

A one-in-two sample was selected for the duplicate search within EDs. Consequently, the estimation of duplicates reflected the effect of this subsampling by appropriately adjusting the weight by a factor of two.

A second consideration also affected estimation of duplicates. In any instance of multiple enumeration, the appearance of the same persons on difference census forms led to multiple chances of selection under the sample design for the E sample. For example, each person on two different census forms had two different opportunities for selection into the within-ED duplicates sample.

To represent both the effects of subsampling and of multiple chances of selection, the within-ED duplicate weight was computed as

$$\text{Within-ED wt} = 2 * \text{E-sample wt} * (n-1)/n$$

where n represents the total number of forms within the ED on which the person appeared.

No subsampling occurred in the estimation of between-ED duplicates. Furthermore, searching between-ED duplications was generally performed according to a hierarchy, so that if a duplication occurred between two different EDs, the E sample search procedures would identify the duplicate if one ED was sampled but not if the other fell into sample instead. Consequently, special factors were generally not required in order to estimate the contribution of between-ED duplications to total duplications.

In a relatively few instances, different EDs did not fall into a hierarchy as a consequence of an operation which could yield more than one ED simultaneously. Special factors were applied in these instances to adjust for multiple chances of selection.

VARIANCE ESTIMATION

The variances estimated for the dual system estimates and other characteristics from the P and E samples were based on the sample design. In other words, the estimated variances measure the effect of expected variation over different possible

random selections of the sample. The derivation of appropriate design-based variance estimators is consequently closely linked to the details of the design. On the other hand, the design-based variance estimators do not depend on any single model for the underlying population.

A replication approach provided the basic strategy for variance estimation for PEP. Specific replication methods that have been applied to other sample surveys for variance estimation include the jackknife and half-sample methods. The replication method chosen for PEP reflected many of the individual complexities of the CPS design and fell into the general class of methods described by Fay.²

The mechanics of the computation of the variances were performed through a replicate weighting approach. This approach expresses the replication method by associating with each sample case a weight for each replicate, expressing the contribution that the case makes to each replicate estimate. Variances for PEP were estimated through the creation of 49 replicate weights for each P- and E-sample case. Dippo, Fay, and Morganstein³ further described this technique and recounted applications to several different surveys. The following section elaborates the features of the probability design that pertain to variance estimation.

Aspects of the Sample Design Affecting Variance Estimation

The first stage of CPS sampling was the selection of sample areas or Primary Sampling Units (PSUs) to represent the whole country. Typically, a PSU was either a 1970 SMSA, or one or more continuous non-SMSA counties. Some PSUs, the self-representing PSUs, were selected into the sample with certainty, that is, without any

²Robert E. Fay, "Some Properties of Estimates of Variance Based on Replication Methods," *Proceedings of the Section on Survey Research Methods*, American Statistical Association: Washington, DC, 1984, pp. 495-500.

³Cathryn S. Dippo, Robert E. Fay, and David M. Morganstein, "Computing Variances from Complex Samples with Replicate Weights," *Proceedings of the Section on Survey Research Methods*, American Statistical Association: Washington, DC, 1984, pp. 489-494.

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random selection. Large SMSAs were typically self-representing. The remaining PSUs were grouped into strata, and one or more PSUs were randomly selected from each stratum.

The first-stage design of the CPS evolved over time. Technical Paper Number 40⁴ describes the design in detail up to 1976, and a paper by Moore, Bettin, Kostanich and Shapiro,⁵ details subsequent modifications to the design reflected in PEP.

The A/C or "461 area" design formed the backbone of the first-stage design for CPS. In the A/C design, an "A" PSU was sampled from each of the strata of non-self-representing PSUs with probability proportional to 1970 population. The strata were then paired, one stratum from each pair selected with equal probability, and a second PSU, a "C" PSU, was drawn from the selected stratum, again with probability proportional to population. In some instances the "C" PSU was the same as the "A" PSU, so that for each pair of strata, two or, more typically, three distinct PSUs were selected.

The primary objective of the A/C design was accurate national estimation. To meet increased interest for State estimates, specifically annual average unemployment rates, the A/C design was modified during the 1970s in States with small populations by converting some PSUs to the status self-representing, and by restratifying and sampling additional PSUs, while still retaining any original A/C PSUs in these States. Three supplementations, denoted D, B, and E, were implemented for this purpose, although the primary interest of the E-supplement was substate areas. The PEP used the full A/B/C/D/E or 643 sample area first-stage design.

The segment constituted the ultimate sampling unit (USU) within PSUs. Segments were of several forms, the most important of which were address and area segments selected from the 1970 census, and new construction segments sampled from building permits in permit issuing

offices. Typically, segments comprised an expected four housing units, although actual sizes of segments varied.

Choice of Variance Estimator

Because of complexities in the CPS design and estimation procedures, strictly design-unbiased estimates of design-based variances are impossible. Even in the 461 area design, sampling of PSUs at the first stage was not independent between strata but governed instead by a controlled selection procedure. Sampling of segments within PSUs was achieved through a complex systematic sampling procedure cutting across the sampled PSUs in each region. Neither circumstance admits a design-unbiased estimate of variance. The non-linear form of estimator reflected in the derivation of the weights also eliminated the possibility of strictly design-unbiased estimates of variance.

In place of the criterion of design-unbiasedness for estimates of variance for PEP, a variance estimator was instead selected to give design-unbiased variance estimates for sample estimates of population totals based upon basic weights for a design similar but not identical to the actual CPS design. This variance estimator was in turn reflected in a set of replicate basic weights for each sampled case.

If $X(O)$ represents an estimate of total for any characteristic of persons based on summing the basic weights for persons with the characteristic, and $X(i)$ represents the total based upon the i -th set of replicate weights,

$$V^*(X) = 4/49 \sum_{i=1}^{49} (X(i) - X(O))^2$$

gives the replication-based variance estimator for $X(O)$ as implemented in PEP. As a matter of definition, the replication-based variance estimator V^* will be said to represent a variance formula if the expectation of V^* over the random process generating the replicate weights agrees with the variance formula. The initial step of the variance estimation was to derive approximate formulas for the variance of estimates of total based on basic weights, and then to represent these formulas by an appropriate choice of replicate basic weights.

The replicate basic weights were then subjected to the same process of noninterview adjustment, first and second-stage adjustment as the original basic weights. The preceding formula for V^* used with final and replicate final weights to estimate the variance of any characteristic in PEP, including the dual-system estimates.

Thus, the starting point for this approach to variance estimation is the assignment of replicate basic weights to the sample cases so that the estimator V^* represents an appropriate variance estimator in expected value.

The problem of making such assignments was divided into three categories: replicate weights for non-self-representing PSUs in States that had not been restratified; replicate weights for non-self-representing PSUs in restratified States; and variation within EDs in self-representing PSUs.

Technical Paper No. 40 documents the variance estimator for non-self-representing PSUs in the 461 area design under the original "A" and "C" samples. Within the pair of "A" strata, the variance of a total is given by

$$\begin{aligned} \text{Var-A/C} = & 1/4 ((X_{11} + X_{12})/2 - X_{21})^2 \\ & + 21/16 (X_{11} - X_{12})^2, \end{aligned}$$

where stratum 1 is the stratum from which the "C" PSU was selected, X_{11} is the "A" PSU in stratum 1, X_{12} is the "C" PSU in stratum 1, and X_{21} is the "A" PSU in stratum 2.

To represent this variance formula through replicate basic weights, the basic weights of all cases within the PSU were multiplied by factors randomly determined according to the following scheme:

PSU	Factors			
X_{11}	.646	1.354	1.612	.388
X_{12}	.646	1.354	.388	1.612
X_{21}	1.707	.293	1.000	1.000
Probability	1/16	1/16	7/16	7/16

In effect, 1/8th of the time the replicate weights represent the first of the two terms in the variance formula and 7/8ths of the time represent the second.

The 49 replicate weights were generated in sets of eight by selecting one of the eight randomly to receive one of the first two columns, also chosen at random. The remaining seven were randomly assigned either the third or fourth columns.

⁴U.S. Bureau of the Census, *op. cit.*

⁵Thomas F. Moore, Paul Bettin, Donna Kostanich, and Gary M. Shapiro, "Overview of Current Population Survey Sample Design," *Proceedings of the Section on Survey Research Methods*, American Statistical Association, Washington, DC, 1979, pp. 121-126.

In PEP, this scheme was applied to all "A" or "C" non-self-representing PSUs in States that had not been restratified. In restratified States, PSUs that were historically "A" or "C" PSUs were excluded from this scheme but instead treated according to the restratification within their States.

In restratified States, typically a single PSU was selected from each stratum. A collapsed stratum variance formula, involving two or occasionally three strata, was employed. In the case of a collapsed pair of strata, one PSU was selected randomly and its basic weights multiplied by 1.5 while the other PSU was multiplied by .5. This process was repeated independently for a total of 49 times.

In Hawaii, a single non-self-representing PSU was paired with a self-representing PSU of similar sample size. In effect, a self-representing PSU was treated as non-self-representing, thus assuring that the effect of between-PSU variance would be included by actually forming an overestimate of variance.

Segments in self-representing PSUs were assigned to panels for variance purposes.

The number of panels within a PSU was chosen to be a power of 2 depending upon the number of sampled segments. The assignment to panels attempted to balance the distribution by rotation group and to reflect the stratification by type of segment and order of selection. If the number of panels created was $2n$, $2n-1$ sets of replicates were created by randomly mapping the panels to the canonical $2n-1$ orthogonal contrasts in the analysis of variance, multiplying the weights of panels mapped to the coefficient 1 by 1.5 and multiplying the weights of panels mapped to the coefficient -1 by .5. In other words, in each replicate, half of the panels were multiplied by 1.5 and half by .5. By independent randomization, additional sets of $2n-1$ replicates were generated to make up the remaining 49 replicates.

A parallel set of replicate weights were created for the E sample. Calculation of replicate weights for non-self-representing PSUs employed the same set of factors as the P sample, since both samples shared the same first-stage design. In other words, if the weights of the segments of a given

non-self-representing PSU in the P sample were multiplied by 1.5 in the first replicate, the weights of the E sample cases in that PSU were similarly multiplied by 1.5. This approach assures proper representation of any covariance between the P and E samples that arises from sharing the identical first-stage design.

Sampling within PSU for the E sample was independent of the P sample. For self-representing PSUs in the E sample, within-PSU variance was represented by the same strategy of panel assignments as the P sample, but all randomization and assignment was independent of the P sample since the sampling itself had been independent. The sampled EDs in the E sample were the counterpart of the segments of the P sample in constituting the ultimate unit of selection for purposes of variance calculation.

Neither the P- or E-sample variance computations reflect a finite population correction for sampling within PSUs. The practical consequences of this are minimal, however.

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